The Glass Industry
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Devitrification Diagrams in Terms of Batch Mixtures

By F. W. PRESTON

AT various times in the last year or so THE GLASS INDUSTRY has been trying to make available to its readers, in simple form, the scientific work of Morey and of Dietzel on the conditions under which glass devitrifies and the readiness with which it does so. The present short article follows the same general thought.

All the diagrams hitherto printed have shown the composition of the glass in percentages of silica, soda, and lime (SiO_2, Na_2O and CaO). To use the diagrams it is therefore necessary to know the analysis of the glass. This may be obtained either by actually analyzing the glass, which is a nasty, messy process, or by calculating it from the batch used. The calculation is very simple, but many glass men cannot do it, and those of us who can, don't unless we are obliged. For it is a mean, contemptible calculation, utterly devoid of inspiration or humor.

Having had occasion several times to make the calculation when friends, at a loss to understand their breakage, began to suspect devitrification though unable to see any trace of it, I decided that devitrification diagrams for practical purposes should be available in terms of the batch, instead of the chemical analysis of the resulting glass. For I found that we always thought of the glass in terms of the batch and not in terms of the analysis.

Theoretically, the batch determines completely what the analysis shall be. There are various sources of error, but these are not great in bottle tanks and the like. Hampton and Gould have recently discussed them in detail for other cases.[1]

In order that the diagrams shall be strictly applicable, it is necessary that the glass be a straight soda-lime-silica glass. No devitrification diagrams are yet available for cases where the lime is replaced by dolomite (introducing magnesia) or where feldspar is used (introducing alumina and potash). Nor are they available for the lead-potash glasses or the borax glasses.

[1] THE GLASS INDUSTRY, Vol. 11, No. 11 (Nov.) 1930, pp. 249-252.

The raw material must be confined to sand, burnt lime or limestone, soda ash and salt cake, if the diagrams are to be used with any great precision.

In Fig. 1 we have the familiar Morey diagram, but instead of the percentages of silica and lime being marked around its margin (see THE GLASS INDUSTRY for April, 1931), we have an inclined network of lines indicating the lb. of lime and of soda ash used to 1,000 lb. of sand. The network covers the whole range of commercial soda lime glasses.

In Fig. 2 the inclined network is converted to a square one, which is much easier to use, and the centigrade degrees are replaced by Fahrenheit ones. Some people will not regard this as an improvement, and they can use Fig. 1. They are scientific folk, and the inclined network won't bother them.

In assessing your glass's liability to devitrification, proceed as follows:

You are supposed to mix your batch in lots containing 1,000 lb. of sand. If you use 1,500 lb. you must figure out how much soda ash and lime you would use if you reduced the sand to 1,000. Then take your soda and lime (in lb. weight per 1,000 lb. of sand) and find whereabouts on the diagram your batch is located.

Use the figures at the left if you use burnt lime, and those on the right for limestone. The soda ash figures are at the bottom. Be very careful to observe that these figures read from right to left, not left to right, or you may plot your point wrongly.

Your plotted point will probably fall somewhere in the 1:3:6 area N O P Q R, and it should fall near the P Q line. A bottle glass will generally be not far from P, while a plate glass will be nearer Q, probaby not far from the line Q R, and perhaps a little above it.

Glasses lying close to P Q have a minimum tendency to devitrify, and if they do so, they throw out a mixture of 1:3:6 and tridymite crystals.

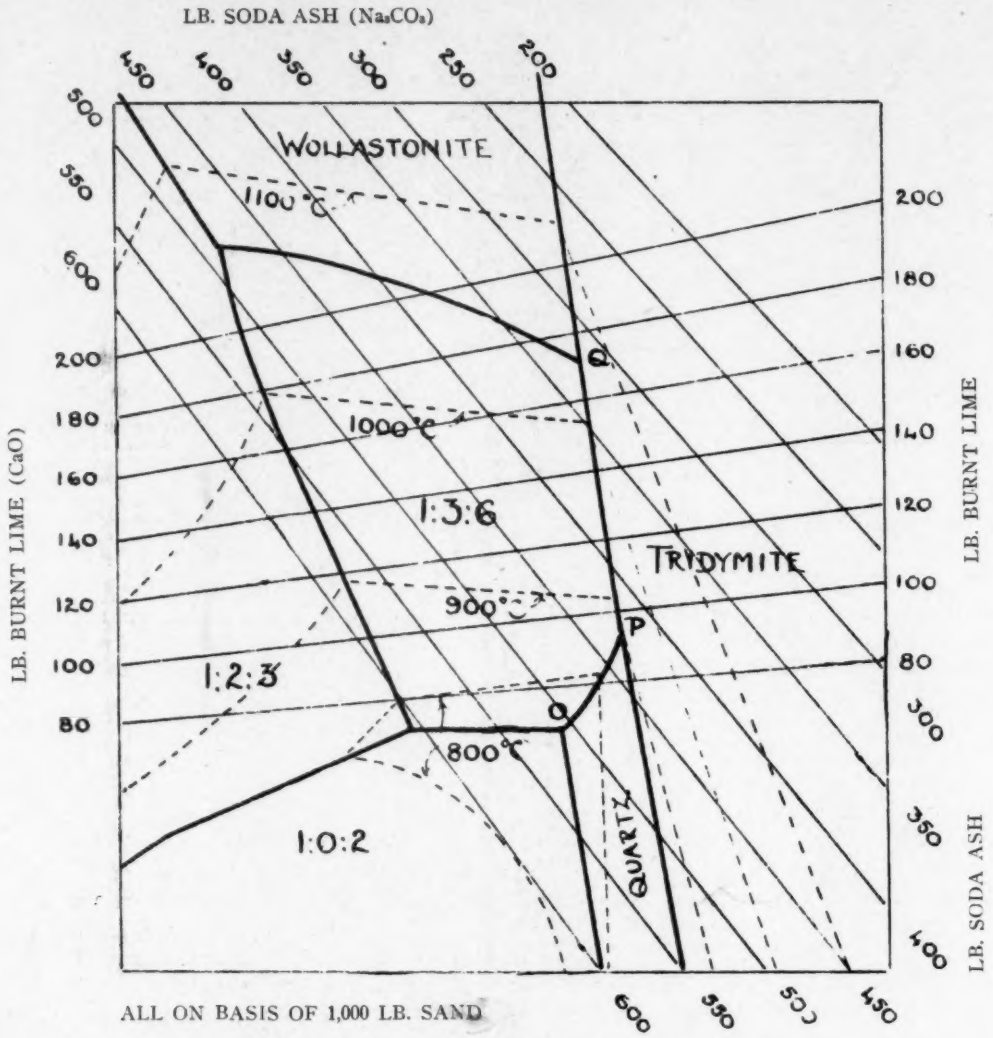
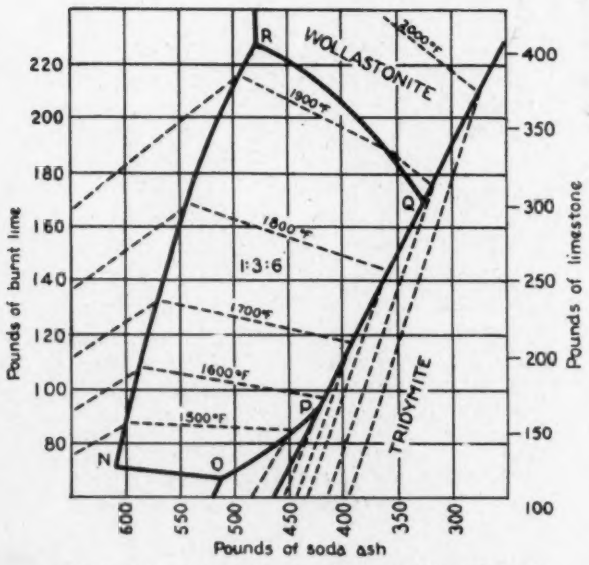


FIG. 1



Note: 1 lb. salt cake is equivalent to ¾ lb. soda ash.

FIG. 2

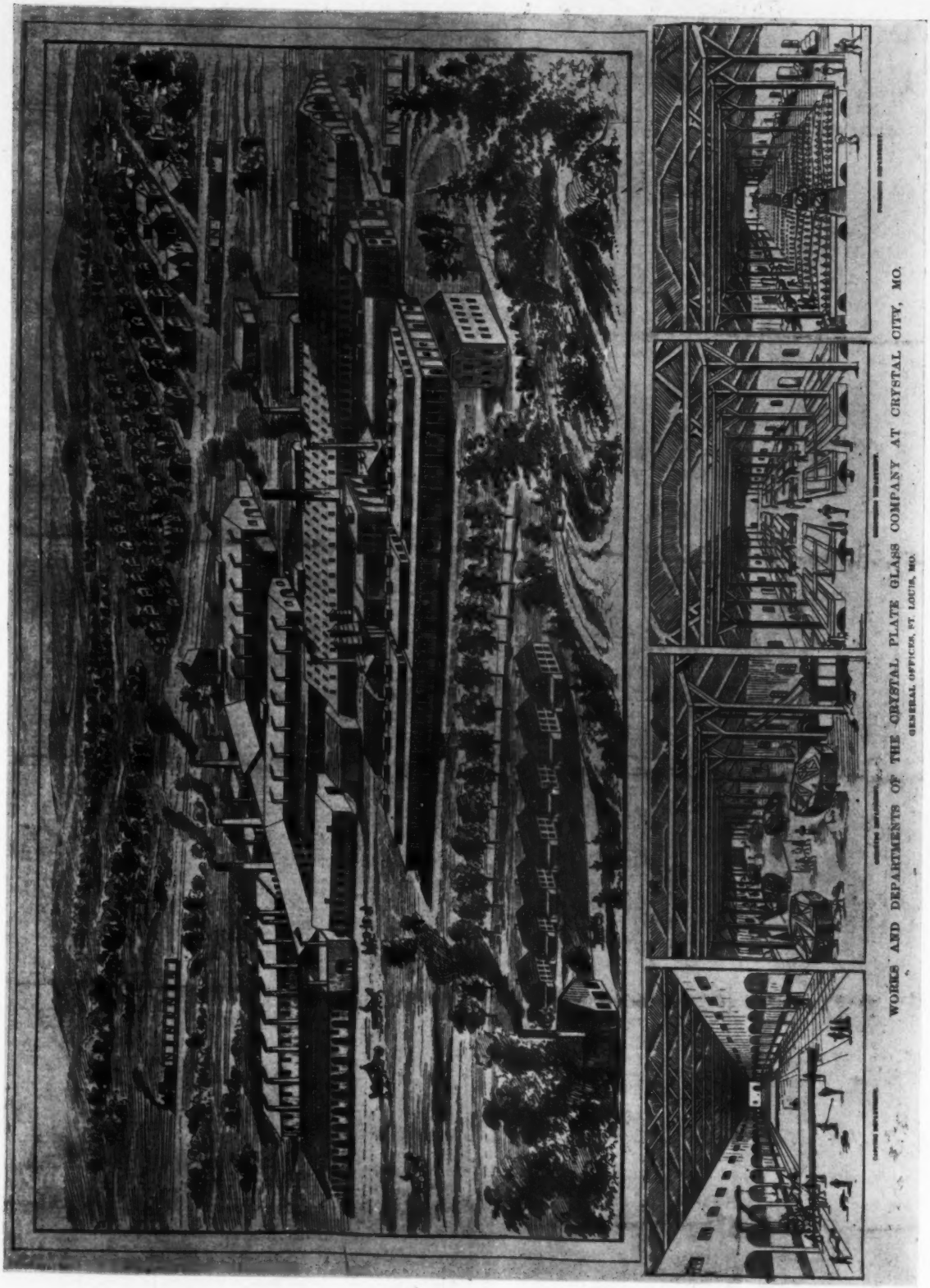
It is dangerous to have the glass lying to the right of the P Q line, for the temperature necessary to keep the glass completely fluid and free from crystals, rises very sharply to the right of the line.

It is dangerous to have the glass *very far* to the left of the P Q line, in particular to get it near R, for although the temperature does not rise steeply in this direction, but rather falls slightly, yet the crystals that form will be 1:3:6 (Na_2O. 3 CaO. C Si O_2) and they grow with great rapidity at certain critical temperatures.

The best place for the plotted point to fall is somewhere in a *narrow band* to the left of P Q, not more than ¼ of the way, from P Q to N R to the left of P Q.

Such a glass will work more sweetly than the one on the P Q line, and there is a certain leeway on the composition before trouble is met. In other words, slight errors of weighing cause less trouble, if the normal composition lies sufficiently to the left of P Q to prevent the errors carrying us to the right of it. There is the further difficulty, that tank glass is generally anything but homogeneous and some streaks of it will contain more silica and some, more soda,

(*Continued on page* 109)



WORKS AND DEPARTMENTS OF THE CRYSTAL PLATE GLASS COMPANY AT CRYSTAL CITY, MO.
GENERAL OFFICES, ST. LOUIS, MO.

FIFTY YEARS AGO (Turn the Page)

PITTSBURGH PLATE GLASS COMPANY WORKS NO. 9
CRYSTAL CITY, MISSOURI
April, 1931

Crystal

THIS panoramic view of the new plate glass plant at Crystal City, Missouri, is taken from the water tower, toward the town side of the works.

The building in the right lower corner is the hospital; to its left is the gate house. The long building behind with the airplane notice on it is the polishing shop. The grinding department is of course in the same building and in the same straight line, since the Crystal City plant is now of the continuous type.

The transformer substation is seen near the center foreground; the building immediately to its right is the end of the lehr building, and behind it is the casting hall with the pot furnace hall in the far distance. Between the grinding sheds and the distance are the warehousing and inspecting departments.

The small building near the left foreground is the oil store, and behind it is the machine shop.

THE old print reproduced on the preceding page appeared in the "Daily Graphic,"—the first illustrated daily paper published in the City of New York,—in its issue of March 29, 1883. Accompanying it was a story descriptive of the factory it pictures, which is reprinted in full on the opposite page.

City Glass Works *FIFTY YEARS AGO AND NOW*

IN ACCORDANCE with the views expressed at the Cove Point Glass Division meeting of 1930, THE GLASS INDUSTRY is endeavoring to gather together data on the history of various plants and enterprises in the glass business in this country. Our managing editor happened to run across this old print and description, in an old print shop, of the Crystal City Plate Glass Works of 50 years ago, and by the courtesy of Mr. H. S. Wherrett, President of the Pittsburgh Plate Glass Company, we have been able to secure from the pen of Mr. R. A. Miller, Technical Sales Engineer of that company, the account which follows of the plant's activities since that date. The work found necessary by Mr. Miller in discovering the ancient records shows how near we already are to losing track of the early history of glassmaking in America, and while printing this account we also publish a plea for those who have old records of Plate Glass Making in America to communicate with us (The GLASS INDUSTRY, 24 West 40th Street, New York), in order that before long a more complete history of the whole industry may be compiled.

(Reprinted from the "Daily Graphic," New York, 1883)

THE CRYSTAL PLATE GLASS COMPANY.

About thirty miles south of St. Louis, on the main line of the St. Louis, Iron Mountain and Southern Railway, is Crystal City, the home of plate glass manufacture in the West. The works of the Crystal Plate Glass Company are located some distance from the station, but a small branch railway affords ready communication at all times. It is but a few years since it was the popular impression that plate glass could not be produced in this country, and that idea is but partially obliterated at the present time, while the facts are that much of the finest and largest plate glass now being used in the finest buildings of all our large cities is made in this country from native material, and is in every respect equal to that of foreign make. In the manufacture of glass of the very best quality the Crystal Plate Glass Company stands in advance of all others. The two things which account for this fact are, first, the superior material—in other words, the Plattin sand—which takes its name from the stream of that name on the banks of which the sand rock quarries lie, and secondly the experience and skill of those under whose management the work is prosecuted. The deposit sand is unquestionably the most extraordinary and valuable that has ever been discovered in the world. Incalculable in its extent, this white sand is here found in a lofty bluff into which tunnels have been driven for a distance of over fifty feet, and from which the invaluable material is obtained in absolute perfection ready for use. It is dazzling white and is perfectly translucent. The company owns 200 acres of this bluff, which averages seventy feet in thickness, and could not be exhausted in hundreds of years. The exceeding purity of the sand has excited the admiration of thousands. An analysis gives the following remarkable results: Silica, 99.62; iron, .09; magnesia, .07. Other indispensable materials required in plate glass production are also found here in exhaustless quantity of the highest order of merit. It may be interesting to state that every ingredient that enters into any formula for the production of plate glass is obtainable in this country save soda ash, and that this can and will be made in St. Louis is but a question of time.

The immense works of the company were commenced in 1872 by the American Plate Glass Company, with a capital stock of $250,000. In 1874 this was raised to $500,000, and in 1880 to $1,000,000. The president of the company is Mr. E. A. Hitchcock, a position he has held from the formation. The manager is Mr. George F. Neale, a gentleman who has been connected with the manufacture of plate glass in Europe and this country ever since his boyhood. Under such experienced management all imperfections have been removed, and the company claims with just pride a production it is willing to submit to competition from any quarter. The process of manufacture of plate glass is very interesting, and it is only possible to fully appreciate it by witnessing the operation from the time the sand is taken from the quarries till the glass comes out of the polishing department in all its perfection. There are seven departments through which the glass goes in the course of manufacture, as follows: 1. The pot room, in which the crucibles and other fine clay articles are prepared. 2. The mixing department, in which materials are mixed preparatory to being melted in the pots. 3. The melting department, with a capacity for melting the contents of forty-eight pots daily, and a fourth gas furnace containing twenty pots is in course of construction. 4. The casting process, which might be called the supreme moment, as in the face of the most intense heat this side of Hades not a moment can be safely lost in the transferral of the great masses of fiery fluid from the pots to the casting tables. 5. The grinding department, where the glass is ground down to a dead level surface by being laid, imbedded in plaster, on a disc grinder 21 feet in diameter. 6. The smoothing department, where the surface is smoothed by an interesting process after it is ground. 7. The polishing department, where, by the use of large felt-covered rubbers, aided by a liquid rouge made from copperas prepared by the company. These processes require a large amount of space, as will be inferred from the views of the works elsewhere published. The grinding and polishing departments occupy buildings 742 by 120 feet and 660 by 116 feet, besides which there are numerous other buildings aggregating many hundred feet in double line, containing (including the furnace and annealing halls) the grinding and polishing department, the pot house in which the crucibles and other fireclay articles are prepared, the grinding and mixing house, two boiler houses, pump house, blacksmith shop and a number of other necessary buildings, all of the most substantial and enduring character.

The machinery and engines consist of three melting furnaces (both gas), 70 annealing kilns, 22 circular grinders, 50 smoothers, 36 polishers and 20 steam engines, together with complete outfits in the very best kinds of machinists' tools and machinery for doing the company's own work, perfect equipments for their own blacksmiths, carpenters, brick-makers and masons, a milling department for grinding limestone, clay and plaster of Paris, and numerous minor but necessary buildings for the correct conduct of this mammoth enterprise. The city contains upwards of 100 frame houses for the use of the operatives and their families, numbering several hundred men, women and children. The situation is a most charming one for residence as well as valuable for manufacturing purposes, and the buildings in all their strength, powerful machinery, the peaceful village with its refining influences, the raw material in its exceeding wealth and purity, and the manufactured article in all the pride of honest construction, combine to produce a marvellously beautiful picture upon the eyes and minds of all who may be so fortunate as to visit this romantically realistic city. The company has made special provisions for the comfort, health, instruction and amusement of its operatives. A fine large hall has been erected. Religious services are held every Sabbath. No drinking is permitted on the company's premises.

Among the buildings that have been supplied with plate-glass from Crystal City are the Iowa State House, Des Moines; the Shillito Buildings, Cincinnati; Barr Building, St. Louis; Sloane and Clarke Buildings, New York, as also the Metropolitan Museum of Art in Central Park, the Custom Houses of Chicago, St. Louis, Little Rock, Ark., and San Francisco; the Tabor Opera House and hotel, Denver, Col.; the Syndicate and other large buildings, Minneapolis, Minn.; Southern Hotel, St. Louis, and a number of the largest and most prominent edifices in Boston, New York, Philadelphia, Chicago, Cincinnati, New Orleans, Cleveland, Nashville and other large cities throughout the country.

The company's officers are: E. A. Hitchcock, President; Dr. J. M. Leete, Vice-President; E. T. Allen, Secretary; C. W. Barnes, Treasurer, and George F. Neale, Manager. The Directors are: Carlos S. Greeley, C. B. Burnham, John H. Maxon, H. S. Platt, Henry Hitchcock, J. M. Leete, J. L. January and E. A. Hitchcock.

Crystal City, Missouri
Works No. 9, Pittsburgh Plate Glass Company

By R. A. MILLER [1]

THE preceding article from an earlier day, furnishes the clue if not the sole excuse for the appearance of the present sketch. Still, as one of the centers of plate glass production, the history of Crystal City, Missouri, should present an element of interest to the readers of THE GLASS INDUSTRY.

* * *

Plate glass has been manufactured at Crystal City, Mo., almost continuously since 1872, when the American Plate Glass Company[2] first produced plate glass there. Many changes have taken place, in methods, personnel, etc., yet the manufacture of plate glass still remains the only real industry of the town. The Sand Mine, which was the original reason for establishing a glass factory at this spot, still remains the chief source of raw material for the glass batch and of abrasive for grinding. The only physical connection between the present and the past, the history of the sand deposit parallels that of the factory.

Several men who were interested in, not to say a part of, the original adventure into plate glass griefs are still living in and about Crystal City and have many interesting tales

[1] Technical Sales Engineer, Pittsburgh Plate Glass Company.

[2] The American Plate Glass Company mentioned here was the first company bearing that name and has no connection whatsoever with the present American Plate Glass Company at Kane, Pa., which was established August 26, 1905, and operated by the Durant interests.

to tell of the old days. The first president of the Crystal Plate Glass Company, which supplanted the American Plate Glass Company was Hon. E. A. Hitchcock, who was later Ambassador to Russia under President McKinley, and Secretary of the Interior under Roosevelt.

The Crystal Plate Glass Company operated as an independent concern until 1895 when the Pittsburgh Plate Glass Company acquired the property along with that of several other glass companies and the status of plate glass as a permanent industry became firmly established. Several other efforts to consolidate the industry had met with failure because of reluctance on the part of one or another to subordinate immediate values to ultimate gain, but the panic of 1893 brought conditions to a head and the formation of the present Pittsburgh Plate Glass Company became a fact.

Through all its vicissitudes and changing supervision, Crystal City plate glass has always been a splendid product and this fact has been fundamental in its repeated rebuilding along the most modern lines of the time, so that its latest rehabilitation which is just now being completed makes it one of the most modern glass factories of the present day.

The story of the changes which have taken place at Crystal City in management and equipment might be merely a list of names and items, were it not for some touches of sentiment and personality here and there. For example, Mr. E. A. Hitchcock once held his factory in operation in a period of depression by the force of his own personality and his ability to persuade the tax commissioners that any increase of taxes meant the cessation of operations. Mr. George F. Neale, general manager from 1877 until 1895, used a police whistle to summon his men for reprimand. At one time when Mr. Hitchcock was away, Mr. Neale returned his pay check because as he said, his job was of sufficient importance to have *his* check signed by the president in person. He was an excellent "glass" man, and became general factory manager for the Pittsburgh Plate Glass Company when Crystal City was taken over, though he left shortly thereafter to take charge of the Standard Plate Glass Company of Butler, Pennsylvania.

During the time that Mr. Hitchcock and Mr. Neale were the leading spirits in Crystal City, Mrs. Hitchcock gave to the town a very beautiful little church and park set out with plants and shrubs from all parts of the globe. This park is just across the road from the factory office, and is still the beauty spot of the town.

Previous to 1895, the maximum production of the factory was about 1,000,000 square feet per year, and the old English grinders and polishers worked hard to produce that! About that time, during the superintendency of Mr. Edward Brown, the octagonal grinding tables were changed to the round type, and the production stepped up to 2,000,000 square feet principally by doing away with the old "smoothers."

During this period there occurred quite a serious break between the jobbers and the manufacturers, so that money was very scarce, and several factories went to the wall. Crystal City was shut down for almost eight months in 1899, and resumed operations in April of 1900 under the supervision of Mr. H. P. Halbach.

Upon the departure of Mr. Halbach in 1902, Mr. W. J. Golightly, then superintendent at Kokomo, Ind., took charge, frequently journeying from Kokomo to Crystal City for a stay extending from two days to two or three weeks, until Mr. S. E. Clark, under the direction of Mr. Golightly as "western manager," took charge in 1904. During Mr. Clark's administration the factory was entirely rebuilt, and thirty-six foot round tables were used in both the grinders and polishers, the glass being left on the same deck for both processes By this time, the capacity of the factory was increased from 2,000,000 square feet in 1906 to 13,000,000 square feet maximum. After 1908, Mr. A. Hart Chandler took charge, and in 1910 Mr. R. O. Stillwell became superintendent, still under the direction of Mr. Golightly, in the most modern factory in the world, with no other like it anywhere.

This very newness was the source of continual troubles and difficulties until finally in 1911, Mr. R. C. Beatty, superintendent at Ford City, was made manager with Mr. G. C. Taylor as local superintendent.

During Mr. Taylor's incumbency, the troubles began to clear up so that he was the first superintendent to make the new factory show a profit. His operation became more and more successful right up to the time of his retirement in 1920, when Mr. G. W. Oakes, the present superintendent, took command.

Most of this time the factory had been run by coal fired boilers and producer gas, although grinder and polisher decks had long been driven by electric motors. In 1904 the largest steam engine ever constructed up to that time was purchased from the Allis Chalmers Company who erected it for display at the St. Louis Fair. Later, immense internal combustion engines of the Diesel type, burning washed producer gas, were installed for generating power at 25 cycles. The vibration from these engines was so great that their location had to be changed twice before it was possible to operate them without shaking the office to pieces, and causing trouble in the factory.

In 1926, high tension power lines of the Central City Power Company of St. Louis were carried near the factory and the motors were all changed over to 60 cycles to utilize this "purchased power" and do away with "home manufacture."

A great many changes and developments have taken place in the plate glass industry in the last few years, so it is not surprising that the Pittsburgh Plate Glass Company should have decided in 1929 to again rebuild Crystal City along the most modern lines. The present factory, utilizes the new "Lee Showers" method of casting plate glass and the most modern continuous process for grinding and polishing. The gas producers have succumbed to natural gas which has been made available by the proximity of the pipe lines carrying gas from Louisiana to St. Louis. Still more recently the practice of producing rouge for polishing at the factory has given way to the purchase of rouge from a "central" rouge plant operated at Creighton, so that now Crystal City is entirely dependent upon outside sources of supply for all of its requirements except sand—which after all is said and done was the original reason for establishing the factory at this point, and remains the reason for maintaining it there.

SOME VIEWS OF CRYSTAL CITY

BIRD'S EYE VIEW SHOWING FOREGROUND AND SURROUNDING COUNTRY

CLOSE-UP VIEW SHOWING MORE CLEARLY TRANSFORMER SUB-STATION AND END OF ADJOINING LEHR BUILDING AND BACKGROUND

A FEW Suggestions IN GLASS

By CLAIRE DARE [1]

YOU! Glassware manufacturers, why not let's have some ornamental pieces for the home in glass, for instance:—

Who would be the interior decorator who wouldn't heartily welcome some glistening glass drapery rods; and rings too. They could come in colors; just think!

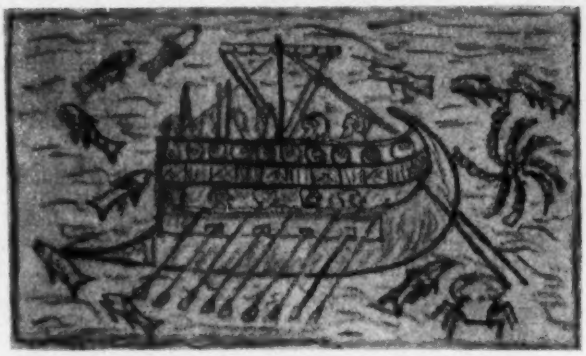
The rods would, of course, come in lengths of various measures to apply to single and double windows. The ends could be finished off in arrow, or ball effect; or they could be fitted with brass trims (a unique combination).

[1] 4015 Thirty-sixth Avenue South, Minneapolis, Minn.

Suggestions for Glass Plaques in relief.

THE ADORATION OF THE SOLAR DISK

ANCIENT EGYPTIAN WAR VESSEL

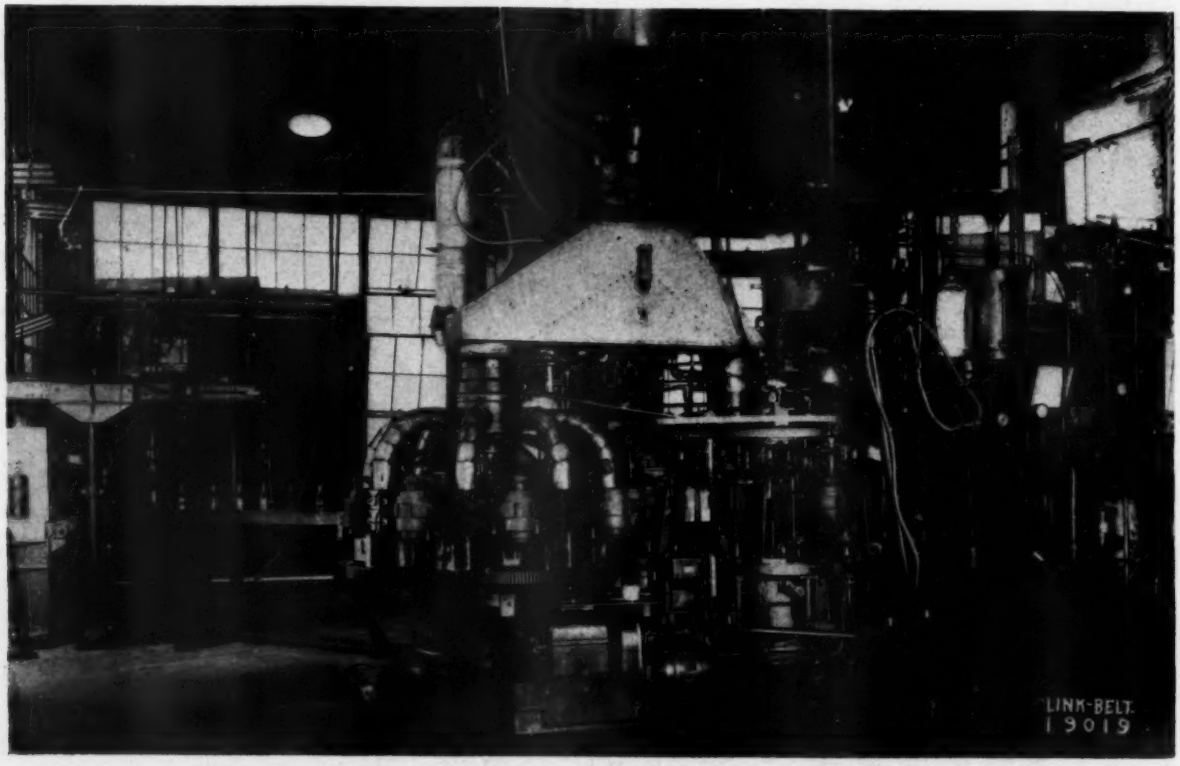


Authentic—traced from ancient drawings.

And why not some figures (persons in dancing pose, animals, birds, even some towering glass buildings—castle effects—trees and flowers) in silhouette,—arranged with a wooden, or metal base, with a groove fitted with clamps, to hold the object in position.

As for myself, I would open my door (and purse strings) to welcome a green glass turtle door-stop. Then too, the ever smart and popular ship model silhouette (in glass), would certainly enhance and add that touch of individuality to the appearance of any room.

And what person wouldn't point with pride to a glass plaque, in relief, hung over the fireplace. What say?



LINK-BELT P. I. V. GEAR (POSITIVE VARIABLE SPEED TRANSMISSION)
Operating Bottle Blowing Machine at the Hartford Empire Company, Hartford, Conn.

The Manufacture of Rolled Plate

By ERNST LUTZ *

(*Continued from the April, 1931, issue*)

This work has been revised, so far as the English and the technical expressions are concerned, by F. W. Preston, who has also added a number of notes relating in general to the special conditions of American practice; but it must be understood that the opinions expressed in the text are those of Mr. Lutz, and neither the Editor nor Dr. Preston accepts responsibility for them.

OF equal influence with the uniformity of heating of the chamber, on the flatness and on the danger of breakage of the rough glass sheet, is the manner of its cooling down. The temperature in the front end, i.e., in the part of the chamber remote from the fire, and with it the temperature of the sheet head, should continue to rise after the insertion of the sheet through the effect of the heat radiation from the other end of the chamber. Immediately after insertion the kiln has therefore to be hermetically sealed; all openings and crevices around the door have to be "mudded up" with clay, so that no cold air can possibly penetrate from outside. In some factories, an hour or two before casting, large wooden blocks were put in an iron basket hanging on the inner side of the front wall, and by their combustion the temperature in this part of the chamber was slightly raised. In other factories this measure became obsolete, as no appreciable advantage was gained.

It is advisable for the heating to be carried on for another one to two hours after the insertion of the sheet but with throttled flues; this prevents the further entrance of cold air; towards the close of this heating the flues have to be shut off entirely and the chamber left to itself for one to two hours. However, during this time the temperatures in the chamber and in the sheet do not equalize completely; the farther end will still remain appreciably warmer than the head and provision must therefore be made that the cooling starts at the sheet end facing the fire, and only gradually progresses towards its middle and head. For this purpose the two doors provided at the farther front wall and at both sides of the fire, are opened at first but slightly and by easy stages. To avoid any mischance the front wall can also be fitted with a greater number of smaller openings, shut up with plugs; instead of opening the doors, in this case the plugs are removed at appropriate intervals. For the same purpose the crown is left with a number of large or small ports, which can be closed either with covers or plugs and opened in succession some hours later. The best sequence of this opening must be found by experiment for each individual furnace. Generally speaking, those ports will be opened first which are in the range of the warmest zone, and only later on are the flues and the doors of the back wall opened wide.

The cooling effect from below through the floor must not be lost sight of. In the annealing kiln as illustrated in Figs. 104 to 107, the space beneath the bottom is only opened towards the front, so that a circulation of the air cannot take place. There are however kilns where, by means of channels provided with valves, this space can be put in communication with the outside, and by the opening of the valves a more or less strong draught can be generated under the kiln bottom. The cooling of the partition walls between adjacent kilns is regulated by separate cooling ducts; there are, however, designs of kilns where these partition walls are either made very thin or are left out entirely, so that the arch of one kiln, going right down to the bottom, thrusts against that of the next oven. Wind and weather conditions, greatly influence the process of cooling, as they determine the change of air in the glass factories. In any case, care must be taken that after the insertion of the sheet, the temperature differences in the chamber do not increase temporarily; they should rather gradually vanish, as otherwise the cracking of the sheet cannot be avoided.

The cooling should follow a course as schematically shown in Fig. 110. The temperatures in the rough glass sheet and

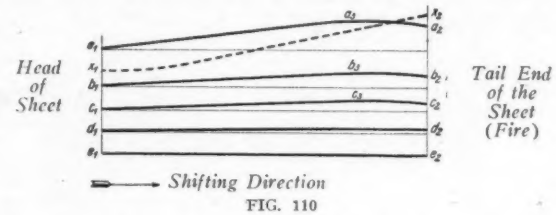


FIG. 110

immediately after its insertion may follow the dotted line x_1 to x_2, wherein the sheet head shows the lowest temperature x_1 and the tail of the sheet the highest temperature x_2. The annealing in the airtight chamber should now equalize the temperature, and at first the line $a_1 - a_2$ at least should be attained. As mentioned before, the hottest zone of the chamber is about three to seven feet away from the fireplace, in consequence the rough glass sheet will for a time show the highest temperature at a_3; starting from this temperature line $a_1 \leftarrow a_3 - a_2$, the further cooling should proceed in such a way that the difference between a_3 and a_1 and the difference between a_3 and a_2 become smaller and smaller, as, for example, shown by the intermediate curves $b_1 - b_3 - b_2$, $c_1 - c_3 - c_2$ and so on, until the temperature all over the plate is one and the same, i.e., until the temperature curve reaches the straight line $e_1 - e_2$. Actually the temperatures of the sheet will follow a less continuous and uniform curve, particularly during the period of the critical temperature range.

* Of Desseau, Germany. This work will appear in German in the forthcoming new edition of *Dralle-Keppeler*, "Die Glasfabrikation," due this year, about July. THE GLASS INDUSTRY probably will by early Fall have completed the English translation, with some comments on its applicability to American conditions by F. W. Preston.

FOOTNOTE: In the Figures, originally prepared for use eventually in the coming new edition in the German language of *Dralle-Keppeler*, "Die Glasfabrikation" in 1931, dimensions are given in metres (*m*) and millimetres (*mm*). We would like to have given these in feet and inches but the translation and the making of nearly two hundred and fifty new illustrations would have involved a prohibitive loss of time and expense. To some of our readers the metric system is as familiar as the English units; for the others we may say that a metre is approximately 40 inches, and a millimetre is approximately 1/25 of an inch. A thousand millimetres, of course, go to a metre.—*F. W. P.*

Fig. 60 shows a glass factory with 2 rows of single chamber kilns. For the present usual sheet size of 28 feet length and 14¾ feet width, the chambers normally have a clear length of 33 feet and a clear width of 16½ feet. With the aid of the roll-trucks the annealed sheets are withdrawn from the kiln and put on wooden platforms, which latter, either traveling on the casting table rails or suspended from the crane, can be brought to the cutting tables.

Fig. 2 shows schematically a rough glass factory with an annealing kiln as used today in almost all plate glass factories. In line with the notation in other glass industries, these kilns are known as "lehrs"; on the continent of Europe they are called "Straku" or "Stracou," which is said to be derived from the German word "Streckofen." In the description of Fig. 2 the working of such a lehr has already been enlarged upon. The lehrs which are in operation in Europe have been built almost exclusively to the designs of the Scotsman, J. W. Cruikshank, formerly of Pittsburgh, Pa.

The illustrations below show the overall arrangement and layout of the lehr with its main parts. It is gas-heated; the distribution of the burners is also shown. The bottom of the five chambers is formed by heavy fire clay bricks of about 12" thickness; the clearances provided between those bricks (⅜ to $\frac{9}{16}$") for expansion, are filled up with asbestos and pulverized fire clay. After their setting, the fire clay bricks have to be accurately aligned with straight edge and water level; the surfaces of the bricks must be machined with great accuracy, so that the bottom, extending through all five chambers, represents accurately a horizontal plane. The arrangement of the electrically-driven stowing tools for the removal of the sheets is also shown. From the chamber V and with the aid of such a tool the sheet is pushed into the lehr runway, and further conveyed by a separate mechanism without any contact with the outside.

The beginning of the runway is formed by the so-called "lift," or "station" which represents the connection between the chamber V and the rods of the lehr mechanism. In the first chamber a temperature of 1,200 to 1,300° F. is usually

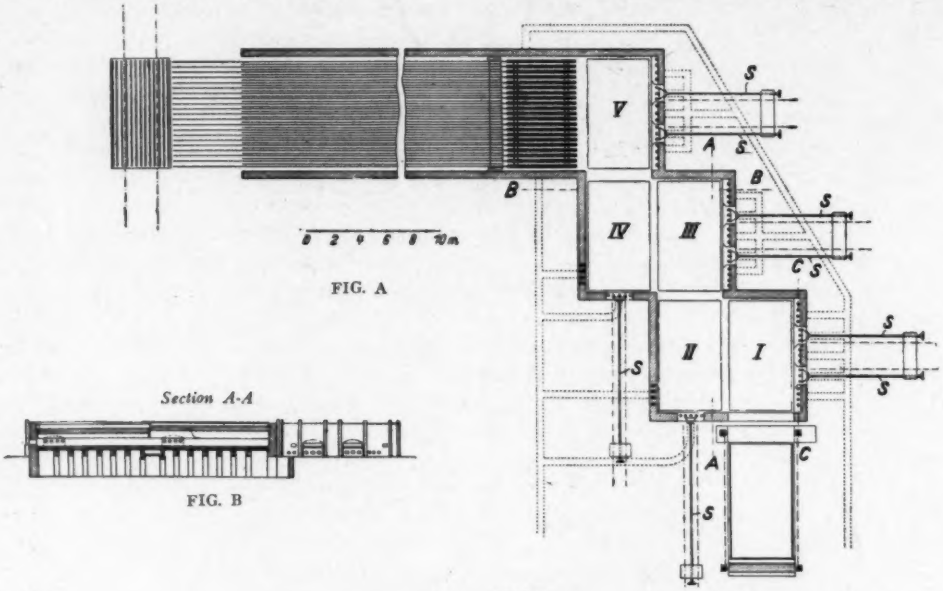


FIG. A

FIG. B

FIG. C

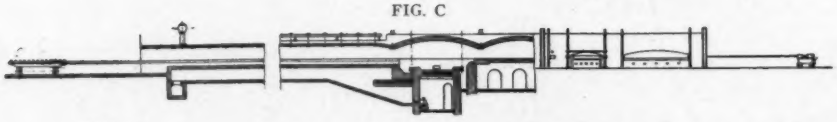
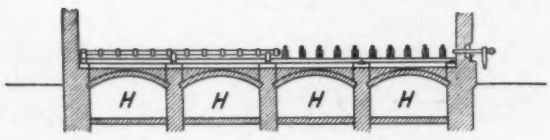


FIG. D



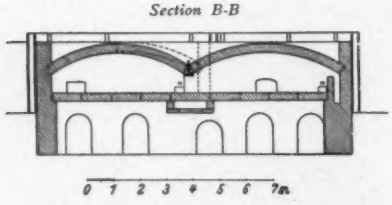


FIG. E

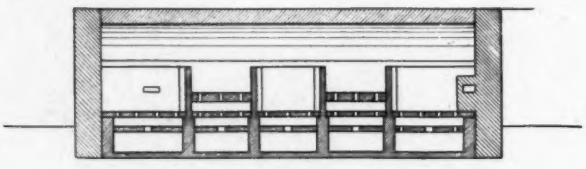


FIG. F

FIG. G

maintained; the temperature decreases from chamber to chamber, reaching about 900° F. at the entrance to the runway and about 130° F. at the exit of the rough glass sheet from the lehr. It would be better if at the exit of the sheet from the lehr the room temperature could be reached—but, with existing plants, 130° F. is the best that is realized.

For the observation of the temperature at various places

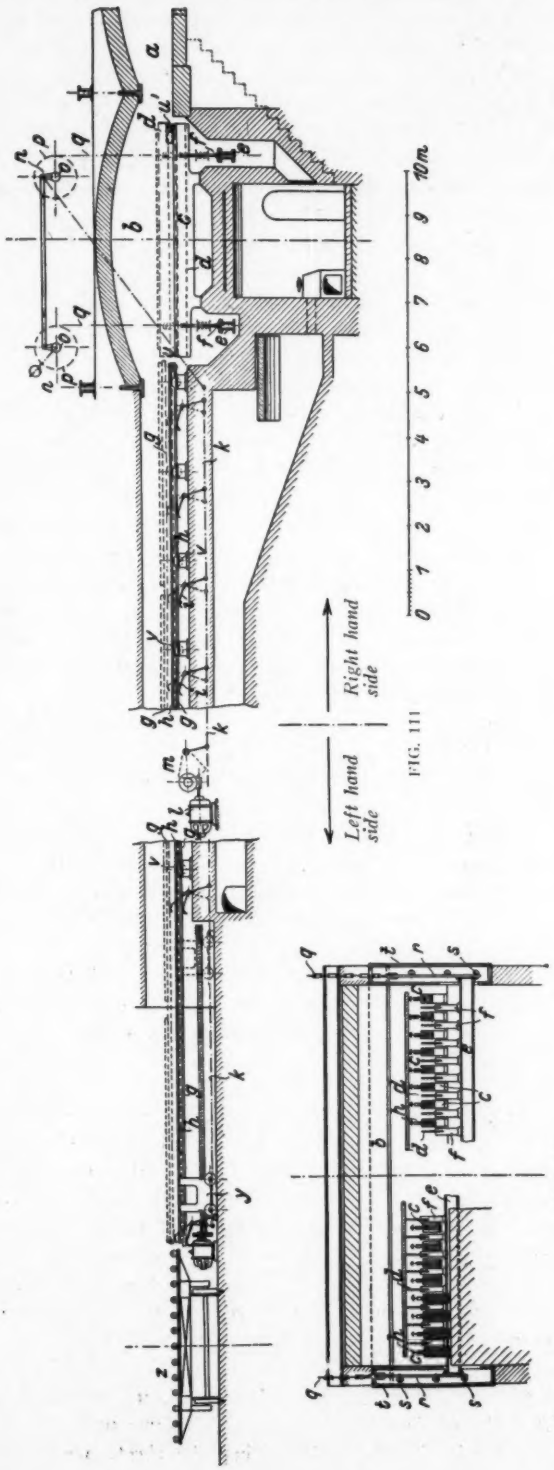


FIG. 111

FIG. 112

along the lehr, thermo-couples, generally platinum-platinum-rhodium elements, are used, and the temperatures read directly on a dial. The temperature scales are co-ordinated on one board, so that the readings of all pyrometers can be taken at a central place. It is further advisable to record all temperatures continuously and to connect each instrument up with a separate recording apparatus, so that at all times the works-staff has an indication of the temperature conditions obtaining in the lehr, and above all so that the management can check whether in between the casting and particularly during the night, the lehr was not too hot or too cold.

It is standard practice to insert one pyrometer through the crown of each oven and 3 or 4 over the length of the runway. These pyrometers should reach as far as possible down towards the rough glass sheets, but care must be taken that they do not get broken by the operation of the stowing tool when conveying the sheets. They must also not come into the immediate neighborhood of a flame, as otherwise they will not indicate the temperature of the sheet proper.

In the middle of the lift and from there onwards at a further distance of 10 to 13 feet there is on each side of the lehr a separate burner, the flame of which passes over the sheet; sometimes a third burner is placed another 16 feet further along the lehr, the flame of which is above the sheet; at intervals of 26 to 40 feet, there are, finally, 2 to 4 more burners on each side, which send their flame beneath the rough glass sheet and beneath the iron parts of the moving mechanism. When using these burners great care must be exercised that the said iron parts do not suffer from the flame. For this reason the runway burners are very rarely used at all. As can be seen in the illustrations, four heating ducts run on the under side of the runway, the burners of which are situated below the lift, about 7 feet below the works floor. This heating from below usually suffices to control the temperature gradient in the lehr-runway.

Shortly after the beginning of the casting, the heating flames have to be gradually throttled, as the freshly rolled sheets themselves carry an appreciable quantity of heat into the lehr; the more sheets that enter the lehr, the less gas is required for its heating and the more easily the whole lehr can be brought to the most favorable temperature gradient. The more sheets cast in succession, the better the performance of the lehr.

The conditions of air and wind* also excercise an important influence on the good work of the lehr; the annealing house should be tight in every direction. For average conditions a chimney of about 100 to 120 feet altitude and with a clear diameter at its top of 4 to 5 feet is sufficient; however, electrically operated machinery for forced draft is usually employed. The stacks for the fire gases going through the lehr, as well as for the gases of the four fires beneath the lehr, are situated at the lehr end.** At about half the length of the lehr its crown is provided with intermediate flues, which communicate by means of an iron sheet tube, with the main flue at the channel end. These intermediate flues are put into operation when the tempera-

*This has rarely been the case in American practice.—F. W. P.
**Sometimes half way down the lehr runway.—F. W. P.

ture gradient in the lehr is too small; but, their operation easily causes unstable temperature conditions, so that whenever possible, they are not used. The temperature gradient is preferably governed by the strength of the individual flames and with the aid of the main flue only.

The first part of the runway, i.e., the space above the "lift," for about 18 feet length, is covered like the ovens by an arch. The next 160 feet of the channel ceiling are formed by fire clay bricks, supported from the lower flanges of cross beams of T-iron. The thickness of the fire clay bricks decreases towards the exit, while in the early part, reckoned from the position of the lift, the heat insulation of the crown is further increased by loosely heaped clay or brick work. The last 160-180 feet of the channel are covered by corrugated sheets carrying a layer of clay, decreasing in thickness towards the end; at its beginning the clay thickness is about 4¾ to 7½ inches, while the last 35 to 50 feet expose the bare metal of the corrugated sheets.

Figs. 111-112 show schematically the lehr moving-mechanism. Every 6 to 10 minutes a new glass sheet is cast and inserted in the lehr; consequently the sheets already in the runway have likewise to be advanced every 6 to 10 minutes one full sheet width plus the clearance in between two sheets, i.e., with present day dimensions, about 16 to 18 feet. Before being carried further along, all sheets in the channel are somewhat lifted with the aid of a vertically moving grid, which is formed by long rods. Now a second grid, the rods of which lie between those of the vertically moving grate, can be moved beneath the sheets in a horizontal direction. When the plates are lifted, the horizontally movable grid, i.e., the so-called "travelling rods," is pushed forwards towards the fifth chamber; then the "lifting rods" are lowered till they lie about ¾ to 1¼ inches lower than the travelling rods. The rough glass sheet will then rest on the travelling rods, and if the latter move exitwards by 16 to 18 feet, the place above the lift will become free for the next sheet, still lying in the fifth oven. The last sheet lying on the rods, i.e., the one which has just left the runway, must have been removed in advance.

In Fig. 111, a indicates the fifth oven and b the space above the lift. With the aid of an electrically operated stowing tool the rough glass sheet is removed from *a* on to the beams *c*, which beams, as shown in Figs. 113-115 consist of cast iron girders, laterally lined with fire clay bricks. This moving is done from outside. The fire clay plates protrude over the cast iron girders, preventing the sheet from touching them and letting it come only in contact with the upper edges of the fire clay bricks; the edges of the latter must be well alined and machined, so that they lie as accurately as possible in a horizontal plane. Usually 20 to 22 such beams are put alongside each other. In between two beams a free space of about 6½ to 7 inches is left. In this space an iron grid, consisting of the rods d, can move up and down; these rods are supported by two cross girders e, which are uniformly lifted and lowered by a lifting mechanism. The bars d are flat irons of about 18 feet length, 7 inches height and 1 inch thickness; their upper edge is bevelled off, so that the rough glass sheet is in contact with a small part of the flat iron only. Evidently the glass sheet in the fifth oven must at this stage be sufficiently stiff, to withstand handling. The distance between the bars d is about 16 inches, and over this span the glass must support itself without deformation. All rods d are so aligned, that their uppermost edges, as well as the uppermost surface of the beam c at each position of the lift, lie in a horizontal plane. With the aid of two little cast iron supports f they rest on the lift girders e, e. In these supports they can be so adjusted that their upper edges all fall in the plane desired.

Fig. 113

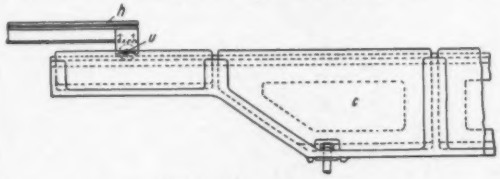


FIG. 114

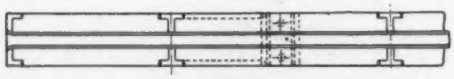


FIG. 115

When the lift rises, the vertically moving rods g are at the same time lifted above the rolls h of the carriage. In the extension of each lift roll -d, there is one vertically-moving rod g and in the extension of each beam c lies a travelling rod h. The vertically-moving rods g rest on levers i (see also Figs. 118 and 119) sitting on cross shafts connected by rods, which run along the outside of the lehr. These rods are provided with counterweights balancing the weights of the up and downwards parts as well as that of the lift; they are operated by a motor of about 8 hp. and a gear segment m. The levers n transmit this movement also to the shafts o, on which are two discs p, winding and unwinding the chains q. On these chains, the ends of the lift girders e (Fig. 112) are suspended by iron plates r, which again are guided in cast iron boxes t by small rollers. The boxes t are anchored in the brick work of the lift room. The chains y are adjustable as regards their length, so that the girders e can be so set, that in any position of the lift they are horizontal and all at the same level.

The carriage rods h at their front end are each fitted with a supporting roller u which, when the carriage is moving, runs in a groove of the corresponding cast iron beam c. (Figs. 111-115). The two front walls of the boxes fixed at the rod ends which contain the rollers u extend right down to the groove, where they form sweepers which collect any cullet and fragments of broken glass which have collected in the grooves. If such a glass piece should be left in the groove, the roller u would have evidently to overcome it, which means that the corresponding rod end would stand apart from the other ones; on the return way this would lead to the breaking of the following sheet lying on the rods. The fragments of glass, which are pushed away at the end of the beam c, fall into pockets from which they can be withdrawn from below and sometimes from all sides. At the moment when all rough glass sheets are somewhat lifted, the carriage below them is withdrawn until the rollers u reach u′ (Fig. 111). Then the sheets are lowered

until they are again lying on the carriage and are ready to be moved 16-18 feet farther towards the lehr exit. The travelling rods h lie on rollers v (Figs. 111, 116 and 117) the protruding shaft of which moves in slits w of the bearing support x. In this way evidently only a very small rolling, and no sliding friction is generated, so that lubrication is not required. The rear end of the travelling

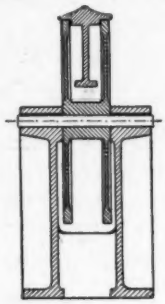


FIG. 116

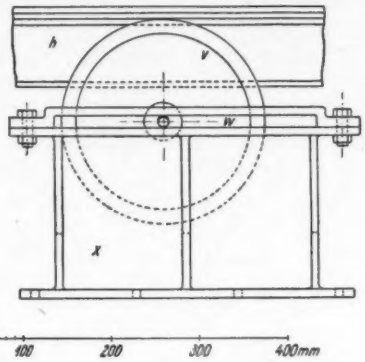


FIG. 117

rods h is fixed to the travelling frame y, which is driven by an electric motor of about 8 HP. This sliding frame pushes the whole carriage, which has a length of over 350 feet, to the fifth oven and also draws it back the same distance.

Such to and fro movement is initiated by the lehr attendant and only after consultation with the foreman

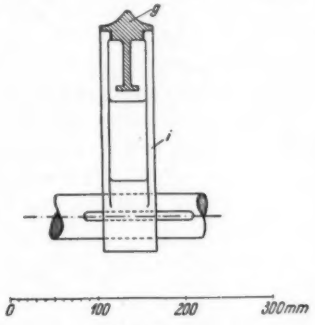


FIG. 118

standing near the head of the lehr. The stand of the lehr attendant, together with the rheostats of the motor for operating the mechanism, is at the end of the lehr, so that he has a clear sight over the exit of the rough glass sheets from the lehr. The communication between the foreman at the head of the lehr and the lehr attendant, which are both more than 400 feet apart from each other, is effected by special signs or bells or by a megaphone, a telephone or the like. It is of first importance for the lehr attendant not to raise the lift before the sheet coming from the fifth chamber lies completely on it.

In between the traveling mechanism of the carriage and that for the vertical shifting of the rough glass sheets, a safety device has to be provided, so that the lehr attendant cannot move the carriage towards the fifth chamber as long as the rough glass sheet is still lying unlifted on the beams c (Fig. 111), i. e., as long as the lift has not moved upwards; this safety device must be so arranged that it can be cut out in exceptional cases. In the end position of the carriage, as well as in the highest and lowest position of the lift, the traveling motor and the lift motor are automatically shut off; further the traveling movements and also the up and down movements are relayed to indicating instruments on the lehr attendant's stand; the latter has thus, at all times, the movements of the mechanism, as well as their position, clearly in sight.

From the end of the lehr the rough glass sheets are pulled on to trucks (Fig. 111) with a separate chain-pulling arrangement. This chain-pulling arangement is driven by a motor of 3 to 4 HP, which again is operated from the lehr attendant's stand. The pushing of the rough glass sheets on the truck (Fig. 111) with the chain-pulling device is further assisted by the turning of the rollers sitting on the roller truck; these rollers are kept in rotation, in the direction of the movement of the sheets, by an electric motor.

As seen in Figs. 116 and 118 the rods of the mechanism have a roof-shaped head, so that the rod and the rough glass sheet only touch along a line and not on a broad surface. The uppermost edges of the rods can be brought the easier into a common plane, the narrower they are; if some single rods should distort under the influence of the heat, then, in contrast to the behavior of broad-faced rod heads, these edges will not, or only slightly, protrude from the common plane. Further, the temperature equalization in the glass will not be disturbed by the iron if the two materials touch in lines, instead of in broad surfaces. The roof-like form of the rod heads has finally the advantage that small glass pieces from broken sheets do not stay on the rods but slide off and drop. With larger glass pieces, which bridge over two rods it may happen that, after repeated lifting and lowering, they also slide and land on the bottom of the groove and so protrude over the rods. This may cause the breaking of the next following sheets; such pieces therefore have to be removed from the outside with iron hooks. In order to examine the interior of the lehr for this purpose the latter must be so lighted by electric bulbs, that the whole interior can be viewed clearly. Further, above and below the mechanism small doors have to be provided in the brick-work, for the inspection of the interior of the lehr. These doors, however, must only be opened in case of emergency; usually they are closed to prevent cool air from striking the glass sheets.

As stated before, the handling of the burners, the flames of which may come into contact with the iron parts of the lift and the other mechanisms, must be done very carefully. On no account should the flames hit the rails and their supports directly; the temperature at the beginning of the runway must never rise so high that the iron parts start to glow. For its easy manoeuvering, the mechanism in all its parts is kept light; if now for example some rods h of the carriage get temporarily red hot, due to carelessness, they will sag through over the interval u to u'. Apart from the fact, that the rough glass sheet lowered by the lift on to the carriage will find an incomplete support, the further consequence thereof may be that the deformation of the rods in question will become permanent.

(To be continued)

Decision in Peiler Patent Case

Abstracts from the Memorandum of the Court

THE following is believed to be an unbiased review prepared by a man of long experience and familiar with all types of glass feeders, of the decision of Judge Charles B. Davis in the United States District Court for the Eastern Division of the Eastern Judiciary District of Missouri in the case of Hartford Empire Company vs. Obear-Nester Company, and Samuel Stuckey, alleging infringement of patents controlled by the plaintiff.

THE plaintiff manufactures glass-working machinery which it leases to glass manufacturers. The defendants are engaged in the manufacture of glassware. This action is taken for the alleged infringement of the following patents owned by the plaintiff: Patents No. 1,405,936, 1,662,436, 1,662,437, granted to Karl E. Peiler and patent No. 1,677,436 granted to Enoc T. Ferngren. In all nineteen claims are in issue.

These patents deal with feeders, for molten glass, having vacuum and pressure creating devices for causing pulsations in the stream of molten glass flowing from the orifice in the bottom of the forehearth. In the Peiler patents intermittent pulsations in an airbell suspended in the glass above the orifice creates pulsations in the glass stream. The height of the airbell is adjustable but the airbell is normally held stationary at a height above the floor that permits the glass to flow to the orifice. The airbell is connected to a pipe through which compression, vacuum and atmosphere are supplied in operation. Compression in the airbell sends the glass through the orifice and the shears sever a mold charge. Vacuum is then applied to withdraw the stub, after which atmosphere is restored to permit the gravity flow of glass to the orifice.

In Peiler's patent No. 1,405,936 the duration of the pressures are independently adjusted by means of two release valves connected to the air conduit; one to release the vacuum and the other the compression. These release valves are actuated by means of cams, the angularities of which are adjustable by means of differentials. A throttle is also provided by means of which the return to normal pressure may be retarded or accelerated.

In the first Peiler patent the release valves are closed by means of springs and opened by means of cams. In the second Peiler patent three valves are used, one for pressure, one for atmosphere and one for vacuum. Each of these valves are actuated by means of two adjustable cams, one for opening and the other for closing the valve.

In Peiler's third patent the pressure and vacuum are created by reciprocating a piston in a cylinder. The cylinder is connected to the air bell by means of two pipes, each provided with check valves and throttles. By means of these throttles the rate at which air may be drawn from or forced into the airbell may be controlled. Two other series of pipes are used to make adjustments of vacuum or pressure at different positions of the piston. The airbell is also equipped with popoff valves by means of which the maximum pressure or vacuum may be regulated.

In Ferngren's patent the airbell is situated over the orifice and moves up and down with each operation. A cup is also provided beneath the orifice and by means of vacuum assists in drawing the glass through the orifice. The use of vacuum in the airbell is only required in working freely flowing glass.

Defendants construction is disclosed in Stuckey's patent No. 1,686,109. The general arrangement of the airbell over the orifice is the same as in the three Peiler patents. Reciprocation of a pump piston creates pressure or vacuum. The valves are a part of the piston and remain in a set position so that in the operation of the pump the movement of the valves always takes place at the end of the stroke and are non-adjustable. They are not accessible to the operator.

Construction of Claims

The patents on their face show that they are improvements and that there were various machines then in common use in the glass feeding practice which operated in much the same manner as the patented devices. The foregoing is amply supported by the prior art introduced in the evidence. Numerous patents have been granted and gradual progress has been made over a long period of time. The rule of construction to be applied in this situation is well established. In R. R. Co. v. Sayles 97 U. S. 554. 24 L. Ed. 1053 it is said: "If the advance toward the thing desired is gradual, and proceeds step by step, so that no one can claim the complete whole, then each is entitled only to the specific form of device which he produces and every other inventor is entitled to his own specific form, so long as it differs from those of his competitors, and does not include theirs."

The evidence did not show that a machine embodying the structure of any of the patents had been built even for demonstration purposes. These are therefore clearly paper patents. Non-use does not deprive the plaintiff of anything clearly described by his invention, but it does, under the circumstances here present prevent the broadening of the scope thereof and requires a strict construction of the claims.

In the prior art were many pneumatic pressure glass feeders. The use of at least two pressures were shown in McCauley's No. 1,281,083, 1,322,318; Howard No. 1,315,668 and Hitchcock No. 805,068 but the plaintiff takes the position that the Peiler patents were the first disclosure of three controllable pressures in feeding molten glass. It is apparent that when compression and vacuum is used it is impossible to revert from one to the other without restoring for a more or less distinct period of atmospheric pressure. The advance that Peiler is conceived to have made is that he used atmospheric pressure for an appreciable period to permit the glass to start a gravity flow toward the orifice. The controversy entering around this point presented a much discussed issue in the case.

The Hitchcock patent discloses a pneumatic suspension charge feeder. It is equipped with a flexible diaphragm from which a pipe leads to the discharge chamber. A cam operates the diaphragm through a lever and an arm. By an

adjustable amount of play between the lever and the arm atmospheric pressure is restored for a determinable period of time between vacuum and pressure. It is the judgment of the court that the prior art patents disclose the use of three pressures for periods of appreciable duration.

The evidence is that the defendant's feeder worked as well without the valves to restore atmospheric pressure as with them. Normal pressure in the forehearth will cause gravity flow at the orifice regardless of the pressure in the bell.

Test of Infringement

"To sustain the charge of infringement the infringing device must be substantially identical with the one alleged to be infringed in (1) the results obtained; (2) the means of attaining the results; and (3) the manner in which its different parts operate and co-operate to produce that result. If the devices are substantially different in either of these respects the charge of infringement is not sustained. In determining the question of infringement of a patent for a combination, it is therefore necessary to look at the mode of operation or the way the device works, as well as at the result and the means by which the result is attained."

Difference Between Peiler's Structure and Defendant's

In Peiler's first patent adjustments permit variance in the speed of the piston in the same stroke, also the beginning and end of the stroke may be changed while in operation. In the defendant's feeder the piston moves at a definite and constant speed throughout the stroke and it is necessary to stop the machine and change cams to make adjustments. In Peiler's device the valves are independently adjustable while in defendant's feeder they can only be opened at the end of the stroke. In Peiler's device adjustments make possible slow or quick changes from pressure to vacuum but in defendant's device there is no adjustment. In the Peiler patents the valves are independently adjustable so that resort to compression, vacuum and atmosphere in various degrees can be had at any time for any duration desired. In defendant's feeder there is no such adjustment possible.

Statements from the Peiler patents themselves make clear that a uniform pressure throughout delivery does not produce a properly formed gob, and the patents solve the problem by providing the adjustments to vary the duration, time and the amount of pressure and vacuum that a charge of proper size and shape may be delivered to the mold.

The defendant's feeder does not produce the same results and does not operate in the same manner. The claims under consideration in the Peiler first patent are not infringed. In the second Peiler patent six of the claims in suit cover apparatus for feeding glass and five of the claims cover methods of feeding glass. In the effort to obtain this patent the patentee planted his case on the proposition that the claims must be interpreted in view of the peculiar pressure producing and controlling mechanism as involved in the valve organization and operation of his device.

Two of the claims have the additional element that the airbell may be lowered at the cession of operation so as to stop the gravity flow from the orifice. These claims are held invalid because they are broader than the disclosure of the patent and also because they were anticipated by the McCauley patents. But if valid they would not be infringed because infringement does not arise by use of one element of a combination but by the employment of all of the elements of the combination or their equivalent.

The method claims contain no reference to the device by which the result is accomplished. No matter how the practice of glass feeding is carried on, if three pressures of appreciable duration are employed, these claims are infringed. Considering the state of the art and the patentee's statement before the department, the position here taken by the plaintiff is presumptious. These claims are invalid.

The machine disclosed in the third Peiler patent is similar to that disclosed in the other patents. But it differs in having the valve construction connected to a pump member and operated by the movement of the pump piston. The plaintiff is entitled to whatever value there is in this construction but is not entitled to anything more. The whole construction, operation and function is so decidedly different from that employed by the defendant, that no infringement can be ascertained.

The single claim in the Ferngren patent even if valid is void because it is not supported by the oath of the inventor.

Summary

The conclusion is that claims 1, 2, 3, and 4 in Peiler's patent No. 1,405,936, and claims 2, 4, 14 and 21 of Peiler's patent No. 1,662,436, and claims 24, 26 and 31 of Peiler's patent No. 1,662,437 and claim 22 Ferngren's patent No. 1,677,436, are not infringed; that said claim 22 is invalid; that claims 24, 25, 26, 27, 31, 33, and 36 of Peiler's patent No. 1,662,436 are invalid, and that said claims are not infringed.

A decree and suggested findings of fact and conclusions of law in compliance with Equity Rule 70½, in accordance with this opinion, may be rendered.

Devitrification Diagrams in Terms of Batch Mixtures

(*Continued from page* 98)

than others. If the average composition lies on the line P Q, then some streaks are going to be to the left and others to the right and the behavior of the two will presumably be more different than if both lie to one side of P Q.

With these points in mind, it is easy to see whether your glass plots satisfactorily or not; one further fact is available—the temperature at which crystals may be expected to begin to form.

Thus a plate glass plotting a trifle due north of Q should be kept at least above 1,900 for teeming. A bottle glass containing 120 lb. of burnt lime and 408 of soda ash, must be kept above 1,700 (at least) in the feeder flow spouts.

If salt cake is used as well as soda ash, take ¾ of the weight of salt cake and add to the soda ash and treat it all as soda ash. This is not a rough approximation but almost mathematically exact.

[*For the convenience of our readers, if they find this method of working out their glass compositions useful, we shall be glad to furnish reprints of the diagram and text*—EDITOR.]

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G. W. Cooper, Managing Editor

Technical Editors

F. W. Preston — Donald E. Sharp

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THE GLASS INDUSTRY'S prestige as the authoritative and leading technical glass trade journal is recognized not only throughout the American industry but also by hundreds of progressive glass manufacturers, their executives, technologists and factory operating staffs, throughout the world.

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Inhomogeneity of Glass

A LARGE part of the glass industry's troubles arises from the fact that the glass in our tanks is not homogeneous. To this cause may be ascribed a great deal of breakage that is often ignorantly attributed to poor annealing. There is probably no aspect of glass working that is in need of more serious attention than the inefficiency of our tanks as mixing machines.

Inhomogeneous glass is variously called "cordy," "reamy," or "lappy." The defect also goes by the name of "striae," "veins," and so on. In essence the glass consists of thin sheets of material of slightly different composition, having different coefficients of expansion. Thus the glass commonly consists of layers of material alternately in compression and tension. Such a glass needs very little provocation to break; the hot-water test will break our bottles, and the wire mesh will break our wire glass under such conditions.

The tank is probably the worst offender in producing this condition. The top heat of a tank produces an equilibrium of the glass adapted to produce a minimum of stirring. If any segregation has taken place in the batch fed to the tank, or if any segregation takes place in melting, the tank will do nothing, or next to nothing, to amend it. If the tank could be fired with bottom heat, or even side heat, a much more vigorous stirring could be obtained, but the limitations of our refractories seem at present to prevent that.

As things stand it is of the greatest importance to lessen the evil as much as possible by feeding absolutely uniform batch, mixing well the exact proportions with great care, and taking great pains to prevent its segregating again before it reaches the dog house.

Not enough attention is being given to this matter in some plants.—*F.W.P.*

Crystallization in Glass

A lecture of quite exceptional interest on this subject was given on April 14 at the Mellon Institute, Pittsburgh, by H. H. Blau of the Macbeth-Evans Glass Company.

"Devitrification" and "Crystallization" in glass were more or less synonymous terms, but devitrification had come to be a term of contumely, the underlying idea being that if glass were devitrified it was to that extent defective. The term "crystallization" had not yet acquired a meaning of obloquy, and was therefore used by the lecturer, who discussed not only some of the unwanted devitrifications but more especially the crystallizations that were wanted—wanted in particular for the production of modern opal glasses.

The diffusion of light by an opal glass has been the subject of some considerable theorizing, but in practice there is much that does not square with the theory. It is therefore necessary to accumulate a great deal of experimental evidence. Perhaps ultimately a more satisfactory theory can be devised. Mr. Blau examined a few of the mathematical conceptions, rather briefly, and then turned to the physics of nucleation and of crystal growth in glasses whose crystallizing particles were fluorides.

The character of the particles, their optimum size, and so on were of great importance; for if too small, the opal was fiery—transmitting a red image of the lamp filament, while scattering the blue light satisfactorily. The optimum size was given as about 1 micron which is 1½ wave lengths of yellow light.

The distribution (spherical) of light around a typical electric light surrounded with the old style and the new styles of opal glass were illustrated with the diagrams, and the truly remarkable effects in producing indirect lighting were well brought out.

Since the production of these minute crystallites under controlled conditions was the very essence of opal glass making (with opal of this type), great attention had been given to the subject, and the bearing of these studies on the composition of normal (transparent) glasses was considered by the lecturer to indicate that there might be more crystallizations in normal glasses than was generally believed.

Mr. Blau hoped that by "sharpening our tools" some of the secrets of the physical nature of glasses would yet be brought into the open, and that the study of opal glasses would be a promising line of attack.

American Glass Technologists No. 2

Donald E. Sharp

Vice-Chairman of the Glass Division, American Ceramic Society

IN our preceding issue we published, from the pen of Dr. Littleton, a brief biography of Dr. Morey, chairman of the Glass Division of the American Ceramic Society. In this issue we give a brief account of D. E. Sharp, the vice-chairman of the same body.

Whereas Dr. Morey finds his chief interests in putting bands around the legs of migrating dicky-birds and in the subtle differences between spleenworts and liverworts (from which labors he rests at times to examine the devitrification of glass), Mr. Sharp finds his chief amusement in music and the arts. His dexterity with the 'cello is known throughout the land, and the University of Wisconsin has not been musical since he left it (1918).

He needs no dicky-bird to do his migrating, but migrates continually himself, so that the place of him knows him no longer, and calling him on long distance usually involves a search of the whole of the Eastern United States.

For a brief period in 1918 Mr. Sharp was located at Pittsburgh, in the Ceramic Department of the Bureau of Standards, but not liking the Pennsylvania air, he returned to New York State (he was born at Corning and for three years was with Corning Glass Works' research department), and became Technical Director of the Spencer Lens Company's Optical Plant at Hamburg, N. Y. Of this plant he became successively manager (1920) and owner (1925), and Hamburg has remained his nominal headquarters since.

In 1929 the Bailey and Sharp Company was organized, Mr. Sharp becoming its President and developing on a larger scale the consulting practice in the glass field which previously he had handled alone.

Mr. Sharp is a director of the Vitaglass Corporation, of the Reflex Highway Sign and Signal Company and the Eno-Sharp Corporation. In addition he finds time to act as director of the Hamburg Savings & Loan Association and the Hamburg Finance Company and as a member of the Board of Education of the Hamburg Schools.

His scientific affiliations include Fellowship in the American Association for the Advancement of Science, and Membership in the American Astronomical, Physical, Optical, Chemical and Ceramic Societies.

Readers of THE GLASS INDUSTRY will recall a variety of articles in our pages by Mr. Sharp, many of a particularly practical and helpful kind. The numerous requests for reprints of these papers testify to their utility. In other journals too Mr. Sharp is well-known as an authority on lens making, the testing of glass and on various other subjects within the glass field.

His work has to be of a high quality, because his wife

DONALD E. SHARP

(nee Harriet Evelyn Minkel, *m.* January 1, 1921), is also a chemist of note, which possibly accounts for the excellence of her breakfasts, to which we can personally testify. —*F. W. P.*

Controlling Projected Light for Floodlight Illumination

A subject of particular interest to engineers and lens manufacturers, because of the proposed design for elaborate night illumination of the exteriors of the buildings of the coming World's Fair in that city, was discussed in a lecture on March 23, before the Chicago Section of the Illuminating Engineering Society by H. P. Gage, chief of the optical division, Corning Glass Works, who has achieved especial distinction in that field.

A Note on Electrometric Titration

By S. R. SCHOLES [1]

IN at least a few laboratories routine testing of sand for acid-soluble iron is done by the electrometric method described by Ferguson and Hostetter.[2]

The apparatus carries a titrating head on an Erlenmeyer flask, commonly consisting of a 3-holed rubber stopper, through which pass the burette tip, the brine-tube leading from the calomel electrode, and the small tube carrying the platinum electrode. It is common practice to wind the platinum electrode wire around the brine-tube, allowing it to terminate in a coil about the curved foot of the brine-tube. The above described apparatus is shown in Fig. 1.

In the writer's laboratory, difficulty had been encountered

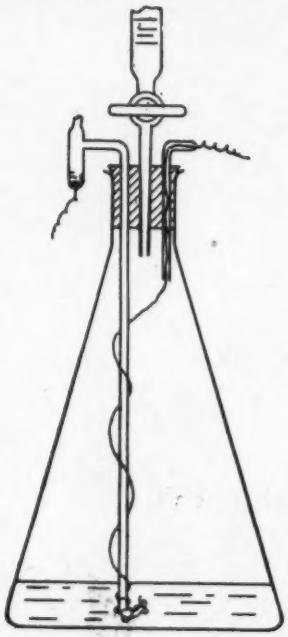


FIG. 1

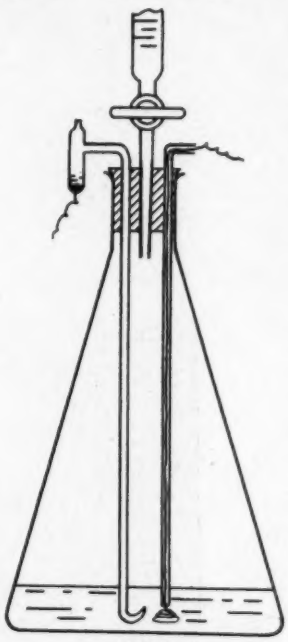


FIG. 2

at times in obtaining satisfactory potentiometer adjustments. There was a wandering, or fading, of the potential. The cause of this was at first located in the fact that the brine-tube hung at an angle from the vertical, bringing the platinum wire under the burette-tip. Thus the solution from the burette fell upon the wire, and as it slowly drained away down the wire it set up incorrect potentials.

Even after this maladjustment was corrected, there seemed to be occasional uncertainty and wandering of potential. On the assumption that spattering from the surface of the solution in the flask might throw drops of dichromate solution upon the wire and cause this irregularity, a change was devised in the tube carrying the platinum electrode.

This tube was made longer, so as to cover the wire as far as beneath the surface of the solution in the flask. The wire was then coiled upon itself. The changed apparatus is shown in Fig. 2.

A distinct improvement in the sharpness of potentiometer adjustments was noted at once. The "breaks," where the stannous chloride is completely oxidized and where the ferrous iron is entirely converted to ferric, are more surely located. This increases our confidence in the accuracy of the method.

[1]Technical Director, Fostoria Glass Company, Moundsville, W. Va.
[2]Jour. Amer. Cer. Soc., Aug., 1919.

Glass Container Men Will Meet in May

The Spring meeting of the Glass Container Association of America is to be held at The Greenbrier Hotel, White Sulphur Springs, West Virginia, May 7 and 8, 1931.

The tentative program is as follows:

On Wednesday, May 6, the Board of Directors will meet at 2 P. M. Thursday, May 7, in the morning at 9:30 the president's address by L. S. Cunningham, Sr., will be given. The reports of E. J. Ackerman, assistant business manager, J. C. Magness, director of traffic, and K. L. Ford, director of research, will be heard. A business meeting will be held at which the report of the treasurer, V. L. Hall will be given, also the nominating committee and the election of directors will take place. Plans for the next three years will be discussed as well as recommendations of the Board of Directors. Directors will meet to elect officers.

On Thursday afternoon the annual golf tournament and ladies' putting contest will take place. Trophies will be awarded in both contests. The evening will be spent at an informal banquet, including the ladies.

On Friday morning, May 8, J. T. Hendricks, director of public relations will speak. C. G. Hicks will tell of the Glass Container Magazine. There will be a discussion of statistics by V. L. Hall and reports of the publicity, tariff, legislative, standardization and membership committees by I. R. Stewart, W. R. Leach, E. F. Glacken, W. S. Richards, J. H. Graham, respectively. C. R. Stevenson, business manager, will address this meeting.

In the afternoon there will be group meetings and conferences.

The program calls attention to the many attractions of White Sulphur Springs, as one of the most beautiful and popular resorts in the country and that on that account it was deemed desirable to arrange a program of particular interest to the ladies. An interesting banquet program to include the ladies has been arranged and other entertainment includes a ladies' putting contest, motion pictures every evening and other additional events.

Those desiring to attend should make their hotel reservation at once directly to The Greenbrier Hotel.

Semet-Solvay Acquires Koller Patents

The Semet-Solvay Engineering Corporation of New York has acquired patents and manufacturing rights relating to the Koller gas producer and the Koller mechanical grate, together with the industrial gas equipment formerly manufactured and sold by the Gas Research Company and the Smith Gas Engineering Company of Dayton, Ohio. Both of these lines will be further developed and marketed with the present Semet-Solvay Engineering gas and coke plant and welded equipment.

American patent rights to the Koller gas producer developed by Carl Koller of Budapest to meet the problem of adequate gas yield when using inferior qualities of fuel were acquired by the Gas Research Company and designs developed to meet American industrial conditions. The producer has been installed by glassmaking, as well as coke, oven, chemical ceramic, steel and automobile plants.

Production of Polished Plate Glass Increasing

The production of polished plate glass in the United States for the month of March, 1931 was 10,592,923 sq. ft., as compared to 8,881,520 sq. ft. produced in the preceding month, February 1931, and 10,415,644 sq. ft. produced in the corresponding month last year, March, 1930, as reported by P. A. Hughes, Secretary of the Plate Glass Manufacturers of America.

This makes a total of 26,795,118 sq. ft. produced in the first quarter of 1931, as compared to 30,238,017 sq. ft., a decrease of approximately 11 per cent, produced in the corresponding period of 1930.

Of Interest to Chemical Analysts

A discovery of platinum has been made west of Obed by homesteaders who were panning for gold. It is understood that it yields about $1,100 to a ton in placer operations.

New Bottle Machine by Lynch Corporation

The Lynch Corporation is now ready to put on the market its Model 10 machine which some of us have been watching with interest for the last year or so. One such machine has been in continuous operation for many months and at the present time one of the leading glass companies of the country has twelve of them in use, while several machines have left or are leaving immediately for Europe. The existence of the machine is of course no secret, though its official introduction to the public took place only recently, when representatives of the technical press met by invitation of the Lynch Corporation and the courtesy of the operating firm, to see the first batteries of the machine at work.

It is illustrated in the Lynch announcement elsewhere in this issue.

A new machine may be judged on two main grounds: the introduction of new principles of operation (its inventive features) and its quality of construction (its engineering features).

On the first count the machine shows up well: the inventions incorporated in the machine have some excellent features, but they are not so radical as to be untried or uncertain of results.

The machine is a two-table, intermittently moving, six-arm affair, making ware up to quart capacity. It is compact and very wide in its scope, being capable of all the ranges of the previous Lynch machine models "B," "L," "LA" and "R." It may, therefore, be regarded as in some sense a perfectly normal type of machine, but there are important innovations.

In the first place, although the motion is intermittent, the character of the motion is not the customary one, inasmuch as the dwelling periods are shorter and the traveling periods longer than usual. This makes for much smoother action. Further, the blowing time is maintained during both the dwelling and traveling periods; this is accomplished by individual blowheads traveling with both the blank and blow molds, and gives at once a longer blowing period than on previous machines and facilities for individual adjustment of the blowing period not possible on previous machines of the same general type.

The net results is an increase in production of 40 to 60 per cent over the older types and in general, a very good distribution of glass in the ware and the possibility of reducing the weight of glass in the ware considerably.

The machine is air-driven, but through a new type of mechanism—new at least in the glass field. The number of air-cylinders has been reduced from 21 to 7, and the air consumption halved, in spite of the 50 per cent increase of production. The present machine takes about 100 cubic feet/min. at 35 40 lb./sq. in pressure.

The finish is set promptly with the aid of a vacuum, in connection with which new features have been incorporated. A vacuum of 26-27 in. is needed and 125 cu. ft. displacement per minute.

Certain other innovations have been introduced of which we hope to say more in a later issue.

Turning now to the second count—the engineering features—the machine shows up exceptionally well. The use of special steel (nickel and nickel chrome) and of nickel bearing irons, all to S. A. E. specifications is a feature of the machine. Steel pins, rollers and bushings hardened and ground are used throughout, as many of the gears are similarly hardened and ground. Massive roller bearings and combined radial and thrust ball bearings are used on the blank invert mechanism, while the invert gear is located between the bearings and not as an overhanging cantilever as in many older types.

The synchronizing of the tables is effected through a train of hardened and ground spur gears in the base of the machine, where they are completely protected from dirt and broken glass and run in an oil bath ensuring perfect lubrication.

With the facilities for individual timing of the blowing periods, it is an easy matter to use six different molds on the same machine at one time, provided the ware is of the same general shape and weight.

The production on one job previously done at 23 pieces per minute was stepped up to 36 with this machine. Another 19 per minute was raised to 32. Several of the machines, in the second week of their existence, averaged a "pack" of approximately 120 gross per shift. This obviously means that there was not much "off" ware.

Lynch machines of various models are in extensive use in many glass-making countries. The corporation's present personnel includes the following: T. C. Werbe, president and treasurer; E. G. Bridges, vice-president and chief engineer; J. L. Watts, secretary and assistant treasurer, and E. Podman, assistant secretary.

This organization is looking forward confidently to substantially increasing their business in the future as a result of the completion of their development of the new Model 10, which has been in progress for the past several years.

Pittsburgh Plate Glass Annual Report

The Pittsburgh Plate Glass Company's annual report for the year ending December 31, 1930 submitted to the stockholders March 11, 1931 by W. L. Clause, chairman of the board and H. S. Wherrett, the president, showed gross earnings for the year 1930 of $9,121,841. Deducting depreciation, obsolescence and depletion, $3,928,303, and reserve for Federal Taxes payable in 1931, $450,000. leaves a net profit for 1930, of $4,743,538. Cash dividends paid in 1930 amounted to $4,322,916. Additions to Plant Investment aggregated $8,844,085 or a net increase in Plant Investment after deducting depreciation, obsolescence and depletion, of $4,915,782.

It was pointed out that unfavorable business conditions in 1930 reduced the domestic consumption of plate glass to approximately 35% below the 1929 figure. Importations of foreign glass showed a corresponding reduction. Notwithstanding the fact that the import rates promulgated by President Coolidge in 1929 were based on a prolonged and comprehensive study by the Tariff Commission, the rates embodied by Congress in the Hawley-Smooth Bill resulted in a substantial decrease in protection.

The report said that the magnitude and character of building operations and the activity of the automobile industry will govern the consumption of plate glass for the current year. The opinion is expressed in some quarters that both industries will show an improvement over 1930, and if so, plate glass consumption will be favorably affected. The manufacturing capacity of the country is in excess of present consumption and the maximum demand experienced in the past.

Factory operations on a reduced schedule have been carried on throughout practically the entire year, with efforts directed toward maintaining the lowest possible cost consisent with a high standard of quality and the volume of production. The new plants at Ford City, Pa., and Crystal City, Mo., referred to a year ago, have warranted expectations in the production of polished plate glass of ⅛" and standard thicknesses.

Two sites for new factories have been acquired; one located at Marysville, Michigan, on the St. Clair River, about sixty miles north of Detroit; and the other at Santa Ana, California, approximately thirty-five miles from Los Angeles and twenty miles from the seaboard. A new plant at Ford City, Pa., to replace the Charleroi, Pa., operation is nearing completion. By June, 1931, the Company will be in a position to supply from this plant its requirements of the Carrara glass, both white and black, heavy polished plate glass, and spectacle and special glasses, all of which had been produced at Charleroi. This will consolidate two factories, at Ford City, ensuring more economical operation.

Duplate (safety) glass. The Duplate Corporation is now a wholly owned subsidiary, the Pittsburgh Plate Glass Company having purchased the DuPont Viscoloid Company's half interest therein. The process by which Duplate is manufactured has been wholly changed and new patents covering the process have been issued to the Duplate Corporation. Growing interest in Duplate is apparent on the part of automobile manufacturers and car owners.

Courcelles (Belgium) Plate Glass Plant. Conditions abroad in the plate glass business have not been materially different from those in this country. Consumption has been sharply curtailed, and profits have declined accordingly.

Sheet Glass. The new plant at Henryetta, Oklahoma, was placed in operation last year as expected, and is being regularly produced at this point as well as at Mt. Vernon, Ohio, and Clarksburg, West Virginia. The industry is operating in an unprofitable period of low prices and light demand.

Tariff Investigation on Gauge Glass Tubes

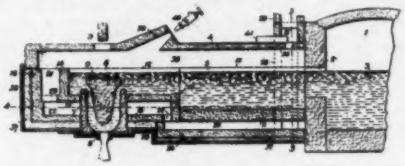
An investigation, No. 57, of the differences in costs of production of gauge glass tubes by foreign and domestic producers was ordered March 24, 1931, by the United States Tariff Commission, to be held at the office of the Commission in Washington, D. C., on a date to be fixed hereafter.

Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

Complete copies of U. S. Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C., Price 10c each

METHOD OF AND MEANS FOR FEEDING GLASS. U. S. 1,792,727. Feb. 17, 1931. Albert R. Bethel, Huntington Park, Cal. Filed 9/22/27. Spout for supplying viscous glass from a furnace having a storage chamber at its inner end communicating with the furnace and a



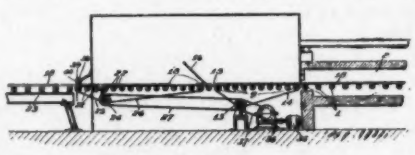
feed chamber at its outer end, a discharge chamber communicating with and extending downwardly through the bottom of the feed chamber, a heating chamber in communication with the top of the spout and partially surrounding the feed chamber and extending beneath the feed and storage chambers and about the downwardly projecting portion of the discharge chamber, means for projecting a heating agent against the surface of the glass in the feed chamber for travel therefrom downwardly into the heating chamber, and an exhaust chamber communicating with the heating chamber adjacent the furnace and having an outlet to the atmosphere.

METHOD OF TRANSFERRING MOLTEN GLASS FROM TANKS INTO POTS. U. S. 1,801,306. Apr. 21, 1931. John L. Drake, Toledo, O., assignor to Libbey-Owens-Ford Glass Company, Toledo, O. Filed 8/23/28. The method of passing molten glass from a tank having an outwardly projecting overflow spout into a pot, which consists in telescoping the pot and spout in a substantially horizontal plane, moving the pot relative to said spout into a substantially vertical position, in simultaneously flowing the molten glass from said tank into said pot, and in preventing the flow of glass from said pot during movement thereof.

APPARATUS FOR MANIPULATING PLATE GLASS AND SIMILAR MATERIALS. U. S. 1,792,576. Feb. 17, 1931. Paul Dryon, Auvelais, Belgium. Filed 12/3/28. An apparatus for transporting and turning over glass plates and similar materials, comprising suckers for supporting the plates, two correlated frames carrying the suckers, a single fitting common to both frames for supporting them, and means for displacing the two frames separately and for bringing them into contact with the plates on both sides of the latter.

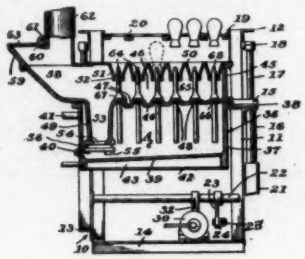
GLASS-TANK FURNACE. U. S. 1,797,590. March 24, 1931. Otto Rosenstein, San Francisco, Calif., assignor to Illinois Pacific Glass Corporation, San Francisco, Cal. Filed 8/23/26. A glass tank furnace of the character described having a bottom wall and side walls, said side walls comprising a lowermost row of bricks substantially less in vertical thickness than said bottom wall, a second row of bricks extending substantially above the top surface of said bottom wall and a third row of bricks extending to a point above the normal top surface of the molten bath contained by the furnace.

APPARATUS FOR CRACKING OFF AND HANDLING SHEET GLASS. U. S. 1,792,653. Feb. 17, 1931. Claud Moxley, Ford City, Pa., assignor to Pittsburgh Plate Glass Company. Filed 1/17/28. A runway for use at the outlet end of a leer, comprising a series of spaced



driven rolls, and a cracking off roll located intermediate two of said driven rolls, an axle on which the cracking off roll is journalled, eccentric bushings secured to the ends of the axle, bearings in which such bushings are mounted for rotary adjustment, and means for turning the axle and bushings to adjust the cracking off roll vertically.

METHOD OF AND APPARATUS FOR TREATING GLASS ARTICLES. U. S. 1,793,893. Feb. 24, 1931. James Bailey, Corning, N. Y., assignor to Corning Glass Works, Corning, N. Y. Filed 11/8/28. The method of treating glass articles which includes supporting them over openings in a chamber partially exhausting the chamber and admitting treating fluid to the chamber under atmospheric pressure and spraying the fluid against the articles.



In an apparatus for treating glass articles, a series of partially exhausted treating units, having openings, article supporting trackways associated with said units and means to simultaneously move the trackways toward or away from the treating units, to move articles carried thereby into or out of closing position with relation to the openings.

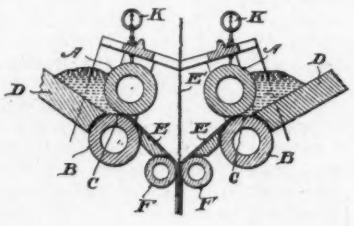
PROCESS OF MAKING ORNAMENTAL MIRRORS. U. S. 1,802,168. George F. Colbert and William H. Colbert, Pittsburgh, Pa., assignors to Liberty Mirror Works. Filed 4/16/29. A process of forming a decorative reflective article, which consists in covering the face of a transparent glass sheet with a metallic film precipitated from a solution, coating said film with a photo-sensitive emulsion, exposing portions of said coating to the action of light, developing said exposed portions to form a pattern so that one-part of the coating is subject to the action of a solvent and the remaining part is not subject to such action, applying solvent to remove the soluble part of the coating, and the underlying parts of said film, and then applying a backing of a color contrasting to that of said film over the entire surface of the sheet carrying said film.

ORNAMENTAL COMPOSITE GLASS. U. S. 1,802,169. Apr. 21, 1931. George F. Colbert and William H. Colbert, Pittsburgh, Pa., assignors to Liberty Mirror Works. Filed 1/10/30.

ORNAMENTAL COMPOSITE GLASS. U. S. 1,802,170. Apr. 21, 1931. George F. Colbert and William H. Colbert, Pittsburgh, Pa., assignors to Liberty Mirror Works. Filed 3/13/30.

MANUFACTURE OF COMPOSITE GLASS. U. S. 1,802,213. Apr. 21, 1931. Herbert John Mallabar, Watford, England. Filed 12/5/27 and in Great Britain 2/24/27. Method of forming composite sheets of glass and cellulose acetate which consists in pretreating glass sheets by coating them with a very thin layer of hardened but still soluble gelatine, coating the sheets so treated with a further layer of soluble gelatine, pretreating a sheet of cellulose acetate with ether, coating said sheet with soluble gelatine, placing said coated sheet of cellulose acetate between said sheets of glass and uniting them together by pressure in presence of a volatile softening liquid for gelatine.

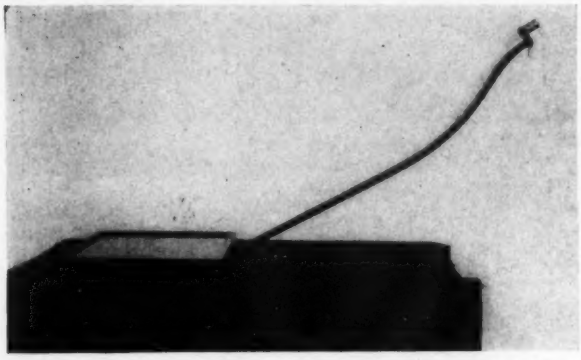
METHOD OF AND APPARATUS FOR ROLLING GLASS SHEETS U. S. 1,801,689. Apr. 21, 1931. Leander N. Pond, Kingsport, Tenn., assignor to Blue Ridge Glass Corp., Kingsport, Tenn. Filed 7/25/29. Process of forming sheet glass at a forming pass which comprises the arresting of the rotation of a roll forming one wall of the pass, and while arrested unequally cooling the same to give an initial warp



to the roll, putting the roll in rotation and feeding glass to the pass at such time that it will contact first with the cooler portion of the roll.

New Carl Zeiss Polariscope

Glass factories must be able to test their products for freedom from stress. It is claimed to be possible, with the Zeiss Stress Tester, to detect quickly and with certainty any stressed parts in the



ZEISS TESTER FOR STRAINED GLASS

glass itself, or any part of the glass under stress caused by holding or fastening the glass.

This tester is a polarization apparatus that makes visible the double refraction of light in stressed glass. The polarizer is the black plane glass plate that is to be illuminated with daylight or a screened ground-glass incandescent lamp. The observation system placed on the long swinging arm, contains the analyzer and a magnifying lens, and is inclined toward the glass plate at an angle that gives the maximum amount of polarized light. In testing for stressed places, the glass to be tested is placed at a height equal to about half that of the observation system, in the polarized light that is reflected by the glass plate. If the glass is then slowly moved back and forth and turned, stressed places are recognized by a change in color in the violet background color of the field of vision; the color change is alternately blue and yellow according to whether the stress is caused by tension or compression, while the part free from stress remains violet like the background color. The magnitude of the stress can be seen by the intensity and extent of the yellow and blue color.

A ground-glass incandescent lamp is placed or fastened on the side opposite the observation system in such a manner that the light falls on the black glass plate at an angle of 30 to 40° (33.5° to be exact).

This device has been introduced by Carl Zeiss, Inc., 485 Fifth Avenue, New York.

New Source of Nitrates

A new product of vital importance to the American chemical industry and of some importance to the glass manufacturing trade is "Arcadian," nitrate of soda. This is manufactured at the great air-nitrogen plant at Hopewell, Va., very accessible to the Southern and Southeast fertilizer consuming regions. It is stated that the production of nitrogen fertilizers has broken the foreign monopoly in this commodity, which formerly controlled selling prices in America.

The Bethelehr

Bethel Engineering Company, whose glass feeder has been in operation for several years in a number of factories have developed and now offer to the trade under the name Bethelehr the latest invention in glassware annealing equipment.

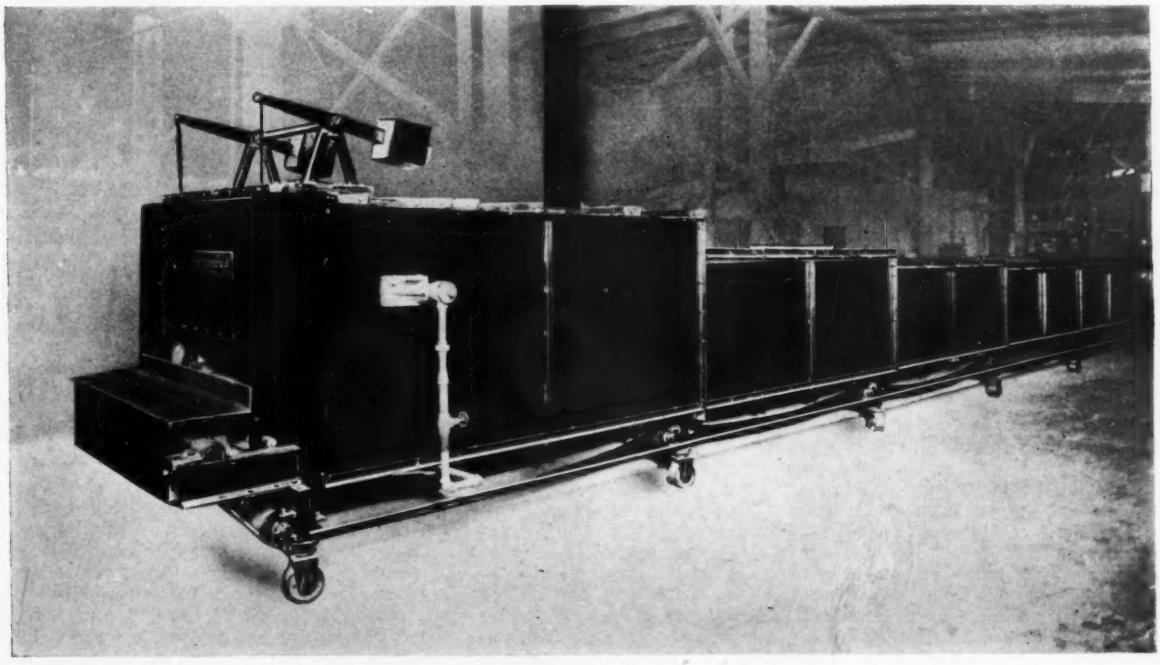
Simplicity, and simplicity of operation are the objects sought and attained. The following description of the new device has been furnished by the company, at Huntington Park, Cal.

In this lehr the cooling is done by radiation alone, the ordinary mechanical methods for controlling the temperature not being used. Carefully designed and properly applied insulation controls the annealing zone. All the heat is applied in the top above the ware, which eliminates any possibility of overheated belts. The heat is muffled, protecting the ware from the fire and making possible uniform color in the ware at all times.

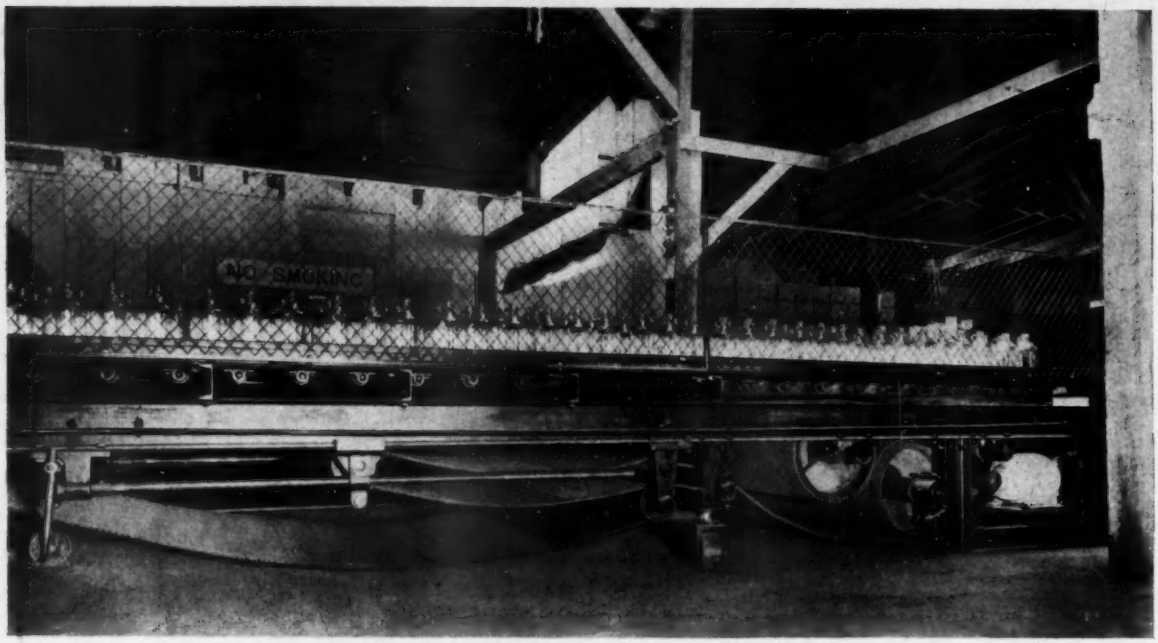
The lehr is mounted on jackscrews, is adjustable for height and readily movable. A perfectly level floor is not required.

The high grade woven wire conveyor belt is driven by two 16-inch rubber-covered rolls. One roll floats to permit the passing of any object accidently falling upon it.

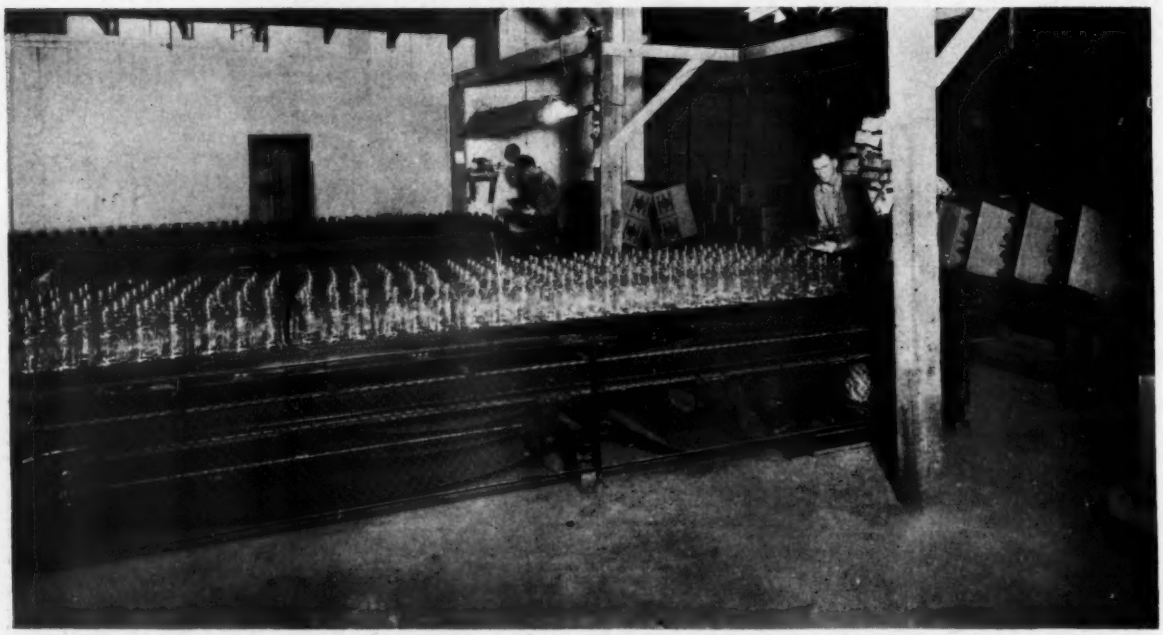
The Bethelehr has no complicated mechanisms to keep in order. Its builders state that it is a sturdy, well constructed piece of machinery with all parts easily accessible for greasing. Connec-



THE LEHR IS MOUNTED ON ROLLERS, FOR PORTABILITY



SHOWING THE WIRE CONVEYOR BELT DRIVING MECHANISM



THE BIG FELLOWS COME ALONG THICK AND FAST

tions are adequately provided for the Alemite lubrication system.

The Bethelehr can be furnished in any size desired. Four feet wide by eighty feet long lehrs are now, it is said, annealing twenty-six tons of ware in twenty-four hours. Ample provision is made at the loading end for possible future installation of loading device by allowing ample extension of the belt and by providing for further extension if necessary. The door at the front is operated on perfectly balanced arms and adjusts to the slightest touch. Side guide rollers are provided for the return section of the belt. The speed is adjustable by turning a hand wheel in the rear of the lehr and can be varied to travel through the lehr in from one to four hours.

Several of these lehrs are in successful operation. It is stated that particularly good results have been attained with ware situated near the sides of the lehr, in comparison with other lehrs in the same factory where the annealing is not always uniform across the whole width of the chamber.

It is reported that the W. J. Latchford Company moved their five gallon equipment from their Compton, Calif., plant to their Los Angeles plant in order to try out the new lehr on the fives, not expecting to get very good results but to obtain information as to what would probably be required in the construction of a special lehr for the fives, and that the very first bottle and subsequent ware showed up perfectly in the polariscope and all the ware for a few days' run tested out in all ways to be much better than they had ever obtained before with annealing ovens that took several days to anneal the ware. The fives went through the Bethelehr in about one hour and thirty minutes.

Postpone Tariff Investigation on Blown Glassware

Under date of March 30, 1931, the United States Tariff Commission announced that Investigation No. 35 for the purpose of determining differences in costs of production of foreign and domestic glassware has been postponed to a date to be announced hereafter.

An application filed July 15, 1930, with the Tariff Commission by the North American Electric Lamp Company, St. Louis, Mo., requesting an investigation on incandescent lamps with filaments of carbon with a view to increasing the duty, has been cancelled.

In connection with Investigation No. 53 by the United States Tariff Commission on non-edible gelatin and glue, a meeting is scheduled at the office of the United States Tariff Commission, Washington, D. C., at 10 A. M., May 28, 1931.

Building Construction Shows Healthy Increase

A healthy sign in the construction industry is seen by F. W. Dodge Corporation in the expected seasonal but well distributed advance in all the thirteen Dodge territories during March over the preceding month, February. A total of $370,406,300 in contracts awarded in the 37 states east of the Rockies is reported for March in comparison with $235,405,100 for February. This was divided into $101,337,600 for residential building, $117,346,900 for non-residential, and $151,721,800 for public works and utilities.

New Company to Operate Turner Glass Plants

The General Glass Corporation, Winchester, Ind., has been organized by I. J. Collins, president of Lancaster Glass Company, Lancaster, O., R. W. Niver, vice president of the Thatcher Manufacturing Company, Elmira, N. Y., and Thomas Fulton, secretary and treasurer of Hocking Glass Company, Lancaster, with a capital reported to be $500,000 to operate the plants of the Turner Glass Corporation recently acquired at a public sale.

It is said that F. W. Mandeville, chairman of the Thatcher Manufacturing Company, was active in the formation of the new organization. Manufacturing operations will be continued at the Terre Haute and Winchester plants.

Death of Prominent Glass Technologist

The death of Dr. Georg Gehloff, director of the famous Osram Glass Works, Berlin, Germany, on March 14, was reported early in April by Professor Alexander Silverman, Head of the Department of Chemistry, University of Pittsburgh. No other particulars were given in the communication received by Professor Silverman. Dr. Gehloff was one of the most prominent glass technologists of Europe. He contributed freely of his knowledge in papers and articles published in technical, society and other glass journals.

Trade Activities

The Bristol Company, Waterbury, Conn. announce the removal of their Pittsburgh office on May 1, 1931, from the Frick Building to Koppers Building, 436 Seventh Avenue. Their new telephone number is Atlantic 1955-6.

The Harshaw Chemical Company, Cleveland, Ohio, recently distributed a booklet listing their industrial chemicals which are used in a large number of industries, including glass, pottery, enamel ware, etc. The items are given in detail for the different kinds and grades and the method of packing for same indicated.

Charles Hardy, Inc., importers and distributers of chemicals for the glass manufacturing and numerous other industries, announced the removal of their offices on April 18 from 122 East 42nd Street to Central Terminal Building, 415 Lexington Avenue, New York City. The new telephone numbers are Murray Hill 2-5930-1-2.

Edward J. Barry of the Libbey Glass Manufacturing Company, Toledo, Ohio, was re-elected president of the National Association of Manufacturers of Pressed and Blown Glassware at the annual meeting held March 10 in Pittsburgh. C. B. Roe of the Fostoria Glass Company, Moundsville, W. Va., is vice-president and as usual John Kunzler continues as secretary-treasurer. Charles E. Voitle is assistant secretary.

Coming Meetings

The American Glassware Manufacturers, Inc., have announced that the date of their annual meeting to be held at Atlantic City, New Jersey, has been tentatively set for Monday, July 13.

The Glass Container Association will hold its annual meeting on May 7 and 8, 1931, at the Greenbrier Hotel, White Sulphur Springs, W. Va. See program elsewhere in this issue.

The American Bottlers of Carbonated Beverages, headquarters Bond Building, Washington, D. C., will hold their annual convention and exposition this year at Dallas, Texas, November 9-13.

The International Congress on Illumination will be held in Great Britain during the period from September 2-19, 1931. Technical sessions will be held in several different cities, the first in Glasgow, Scotland. Numerous illuminating engineering associations will hold meetings on various dates and at various places. Those desiring to attend the Congress are requested to get in touch with the Illuminating Engineering Association, 29 W. 39th Street, New York.

Inquiries Received

For further information address THE GLASS INDUSTRY.

543. Please give us the names of glass manufacturers making glass battery jars.

544. Where can we obtain a portable glass edge-grinder?

545. Please give us the names of concerns which can furnish glass display equipment and other articles for confectioners' use.

546. Who can furnish small liquor tumblers of good quality in substantial lots?

547. Please refer us to concerns who make small pressed glass specialties.

548. Please refer us to manufacturers of machinery "for blowing, cutting, edge filing and washing hollow glassware," for export.

What the World Wants

Specific Inquiries for American Goods Received in the Department of Commerce, Washington, D. C. For further information write the department.

Argentina—50779. Glass jars for preserves.
Canada—50907. Glass fish bowls, round drum and squat shapes.
France—50889. Glass, safety, automobile.
Brazil—50927. Glass, sheet, opalescent, cathedral, art and window.
Porto Rico—51025. Glass bottles and jars.
Brazil—50979. Glass, window and other.
Panama—51034. Glassware, especially prescription bottles.
Domestic—51145. Glassware and crockery.
England—51235. Glassware, pottery, and china.
Scotland—51239. Glass, window, sheet and plate.

Readers Wants and Offers

Address answers to all "keyed" ads c/o The GLASS INDUSTRY 24 West 40th St., New York

EXPERIENCED GLASSHOUSE MAN

With 20 years' experience in glasshouse engineering, building and operation; expert on colors either pot or tank operation: all types of fuel; can handle men and insure production; experienced in hand and machine operation either blown or pressed ware; temperate habits; desires position with progressive glass concern or engineering firm. Address "Class. MY-3."

SUPERINTENDENT

WANTED: A position by a former superintendent of a large glass plant, with 12 years' experience, thoroughly familiar with the continuous process in the manufacture of plate glass and laminated glass. Address "Class. MY-1."

SITUATION WANTED

By Glass Technologist and Engineer, as factory manager now employed. Many years' experience on both plain and colored glass, tanks and pot furnaces. Would like to get in touch with some progressive company who wants to do things. Address "Class MY-2."

BACK NUMBERS WANTED

Will pay moderate premium for copies in good condition of THE GLASS INDUSTRY. Vol. 12, January, 1931. Address THE GLASS INDUSTRY, as above.

Current Prices of Glass-Making Materials

April 21, 1931

Quotations furnished by various producers, manufacturers and dealers

		Carlots	Less Carlots
Acid			
Citric (dom.)	lb.	.37	.37
Hydrochloric (HCl) 20° tanks, per 100 lb		..	1.10
Hydrofluoric (HF) 60% (lead carboy)	lb.	..	.13½
52% and 48%	lb.	.10	.10-.11½
Nitric (HNO_3) 38° carboy ext. Per 100 lb.		5.50	..
Sulphuric (H_2SO_4) 66° tank cars	ton	15.50	..
Tartaric	lb.	..	.31½
Alcohol, denatured	gal.	..	..
Aluminum hydrate ($Al(OH)_3$)	lb.	.04½-.05	.05½-.06
Aluminum oxide (Al_2O_3)	lb	..	.07
Ammonium bifluoride (NH_4) FHF	lb.	..	.19
Ammonia water (NH_4OH) 26° drums	lb.	.02½	.02¾
Antimony, metallic (Sb)	lb.	..	.09¾
Antimony oxide (Sb_2O_3)	lb.	..	.09¾
Antimony sulphide (Sb_2S_3)	lb.	..	.14
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.04	.04½
Barium carbonate ($BaCO_3$), Crude, (Witherite) 90%, 99% through 200 mesh	ton	47.00	..
90% through 100 mesh	ton	44.00	..
Barium hydrate ($Ba(OH)_2$)	lb.	..	.05
Barium mixture, glassmaker's, f.o.b. St. Louis	ton	25.00	..
Barium nitrate ($Ba(NO_3)_2$)	lb.	.07½	.08
Barium selenite ($BaSeO_3$)	lb.	..	..
Barium sulphate, in bags	ton	19.00	24.00
Barium sulphate, glassmaker's, carlots, bulk, f.o.b. shipping point,	ton	15.00-16.00	18.00
Bone ash	carlots, lb.	.06	.06½
Borax ($Na_2B_4O_7 10H_2O$)	lb.	..	.0355-.0425
Crystal	lb.	.028-.033	..
Granulated	lb.	.025-.03	..
Powdered	lb.	.02875-.03375	..
Boric acid (H_3BO_3)	lb.	.0625-.07125	.0625-.08125
Refined	lb.	.0625-.07125	.07125-.08125
Cadmium sulphide (CdS)—			
Red	lb	..	.65-.90
Orange	lb.	..	.65-.90
Yellow	lb.	..	1.30-1.50
Chromium oxide (Cr_2O_3)	lb.	.23	.24
Cobalt oxide (Co_2O_3)			
In bbls.	lb.	..	1.70-1.85
In 10 lb. tins	lb.	..	1.85
Copper oxide			
Red (Cu_2O)	lb.	..	.25
Black (CuO)	lb.	..	.18-.25
Black prepared	lb.	..	.22
Cryolite ($Na_3Al F_6$) Natural Greenland Kryolith)	lb.	.09	.10-.10½
Synthetic (Artificial)	lb.		.09½
Epsom salts ($MgSO_4$) (imported) Per 100 lb.		..	1.15-1.20
Feldspar—			
100 mesh	ton	12.00-18.00	13.50-20.00
80 mesh	ton	11.00-11.75	14.50
40 mesh	ton	11.00	13.50
20 mesh	ton	10.00	10.50
Fluorspar (CaF_2) domestic, ground, 95-98% (max SiO_2, 2½%)			
Bulk, carloads, f.o.b. mines	ton	32.50	..
In bags or barrels	ton	36.50	41.50
Imported	ton	36.50	38.50-40.00
Formaldehyde	lb.	..	.07
Graphite (C)	lb	..	.04-.07
Iron oxide—			
Red (Fe_2O_3)	lb	..	.0450
Black (FeO)	lb	.04½	..
Kaolin (f.o.b. mine)	ton	8.00-9.00	..
English, lump, f.o.b. New York	ton	14.50-25.00	24.50-30.00
Kryolith (see Cryolite)		**Carlots**	**Less Carlots**
Lead chromate ($PbCrO_4$)	lb	..	30
Lead oxide (Pb_3O_4) (red lead)	lb.	.07	.08
Litharge (PbO)	lb.	.06	.07
Lime—			
Hydrated ($Ca(OH)_2$) (in paper sacks)	ton	7.00	7.00
Burnt (CaO) ground, in bulk	ton	6.00	..
Burnt, ground, in paper sacks	ton	8.00	8.00
Burnt, ground, in 280 lb. bbls.	Per bbl.	2.15	..
Limestone ($CaCO_3$)		1.75-2.50	1.75-2.50
Magnesia (MgO)—			
Calcined, heavy (in bbls.)	lb.	.06	.07
light (in bbls.)	lb.	..	.23
extra light (in bbls.)	lb.	..	.37
Magnesium carbonate ($MgCO_3$)	lb.	.06	.07-.10½
Manganese 85% (MnO_2)	lb.	.03	.03
Nickel oxide (Ni_2O_3), black— for nickel content	lb.	..	.35
Nickel monoxide (NiO), green— for nickel content	lb.	..	.35
Plaster of Paris, bags	ton	21.00	23.00-29.00
Potassium bichromate ($K_2Cr_2O_7$)—			
Crystals	lb.	.09	.09¼
Ground	lb	.11	.12
Potassium carbonate—94-96%	lb.	.0555	.0555
Calcined (K_2CO_3) 96-98%	lb.	.06½	.07¼
Hydrated 80-85%	lb.	.05¾	.06¼
Potassium chromate (K_2CrO_4)	lb.	..	.23-.32
Potassium hydrate (KOH) (caustic potash)	lb.	.07½	.08
Potassium nitrate (KNO_3) (gran.)	lb.	..	.06½-.06¾
Potassium permanganate ($KMnO_4$)	lb.	.16	.17
Powdered blue	lb.	..	.22
Rochelle salts, bbls.	lb.	..	.19
Rouge	lb.	..	..
Rutile (TiO_2) powdered, 95%	lb	.15-.20	.20-.25
Salt cake, glassmakers (Na_2SO_4)	ton	22.00	..
Selenium (Se)	lb	..	1.80
Silver nitrate ($AgNO_3$)	(100 oz.) per oz.	..	.23
Soda ash (Na_2CO_3) dense, 58%—			
Bulk, on contract	Flat per 100 lb.	1.07½	..
In barrels	Per 100 lb.	1.38	1.90-2.00
In bags	Per 100 lb.	1.17½	1.72½
Spot orders.. .025 per 100 lbs. higher		..	..
Sodium bichromate ($Na_2Cr_2O_7$)	lb	.07	.07½
Sodium hydrate (NaOH) (caustic soda) Solid	Per 100 lb.	2.50	..
Sodium nitrate ($NaNO_3$)—			
Refined (gran.) in bbls.	lb.	.03¾	.04½
95 per cent	Per 100 lb.	2.01½-2.08	2.15-2.25
Sodium selenite (Na_2SeO_3)	lb	..	2.00
Sodium fluosilicate (Na_2SiF_6)	lb.	.05	.05½
Sodium uranate (Na_2UO_4) Yellow or Orange	lb.	..	1.50-1.55
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb	3.45	3.80-4.00
Flowers, in bags	Per 100 lb	3.10	3.45-3.65
Flour, heavy in bbls.	Per 100 lb	2.85	3.20-3.40
Tin chloride ($SnCl_2$) (crystals)	lb.	.37½	.39
Tin oxide (SnO_2) in bbls.	lb.	.28	.30-.35
Uranium oxide (UO_2) (black, 96% U_3O_8) 100 lb. lots. Black	lb.	..	2.75
Yellow	lb.	..	1.50
Zinc oxide (ZnO)	lb.	.08½	.12
American process, Bags	lb.	.06½	.07
Zircon			
Granular (Milled .005-.02c higher)		.07	.07½-.08
Crude, Gran. (Milled .005-.02c higher)		03¼	04-.05

Monthly Summary of United States Foreign Commerce in Glass

EXPORTS

Corrected to March 25, 1931.

		February 1930 Quantity	February 1930 Value	February 1931 Quantity	February 1931 Value	Two Months Ending February 1930 Quantity	Two Months Ending February 1930 Value	Two Months Ending February 1931 Quantity	Two Months Ending February 1931 Value
Glass and glass products (Total)		.....	$703,153	.....	$634,231	...	$1,492,505	.....	$1,281,746
Plate and window glass—									
Window glass, common, box 50 sq. ft.		618	2,738	516	2,387	3,514	18,446	1,329	6,762
Plate glass, unsilvered, sq. ft.		159,406	58,364	406,513	122,786	337,740	123,915	780,549	229,010
Other window and plate glass	lbs.	532,377	47,298	268,137	27,029	905,569	75,423	673,464	59,572
Glass containers (bottles, vials and jars)		.....	213,690	.. ..	143,543	.. ..	459,837	.. ..	353,698
Table glassware, plain		.. ..	89,782	.. ..	76,119	.. ..	210,103	.. ..	144,025
Table and other glassware, cut or engraved		.....	7,670	.. ..	4,452	.. ..	15,862	.....	7,901
Lamp chimneys and lantern globes	lbs.	.....	20,770	.. ..	8,716	.. ..	37,230	.. ..	22,040
Globes and shades for lighting fixtures	lbs.	.. ..	58,227	.. ..	27,567	.. ..	110,378	.. ..	72,786
Chemical glassware	lbs.	18,556	15,025	9,872	11,147	41,645	37,304	24,658	26,372
Electrical glassware, except for lighting	lbs.	301,471	22,281	139,241	9,875	816,409	59,909	245,288	20,639
Other glassware		.. ..	167,308	.. ..	200,610	.. ..	344,098	.. ..	338,941

IMPORTS

Corrected to March 25, 1931.

Glass and glass products		.. ..	$842,293	.. ..	$469,527	.....	$1,704,211	.. ..	$964,736
Cylinder, crown, and sheet—									
Plain	dut. lb.	2,128,053	78,236	1,200,354	40,049	5,058,192	192,705	1,978,314	72,769
Bent, beveled, colored, etc.	dut. lb.		31,817	187,830	20,938	.....	75,764	325,532	41,444
Plate glass	dut. sq. ft.	765,940	174,559	416,327	126,678	1,456,765	321,516	807,258	227,062
Glass mirrors		.. ..	.. ..	4	4	.. ..	.....	192	387
Rolled, cylinder, crown, and sheet glass, ground, obscured, bent, beveled, colored, etc.		.. ..	.. ..	.. ..	5,336	.....	.....	.....	9,518
Laminated glass and manufactures, and plated glass		.. ..	.....	.	838	....	.. ..	.....	1,767
Bottles, vials, jars, and other containers		.. ..	132,993	.. ..	36,178	.. ..	234,781	.....	80,757
Scientific articles and utensils	dut.	.. ..	38,360	.. ..	24,533	....	89,386	.....	55,251
Tubes and rods	dut.	.. ..	.....	.	10,969	.....	.. ..	.....	17,589
Illuminating articles	dut.	.. ..	104,999	.. ..	26,447	.. ..	162,239	.....	67,288
Blown glass articles—									
Bulbs for electric lamps, without filament	dut.	1,247,384	10,612	1,092,164	10,480	2,952,185	25,650	2,572,072	23,920
Other blown glass articles	dut.	.....	161,979	.....	105,308	.. ..	370,755	.....	228,895
Pressed glass articles		.. ..	18,411	.....	12,200	.. ..	34,752	.....	21,804
Other glassware		.....	90,327	.....	49,569	.. ..	196,663	.....	116,285